COMPULSORY VACCINATION IN THE UNITED STATES: ETHICS, REGULATIONS, AND RECOMMENDATIONS

Ariella R. Noorily

TC 660H
Plan II Honors Program
The University of Texas at Austin

May 11, 2017

Jason Upton, Ph.D.
Department of Molecular Biosciences
Supervising Professor

Janet Davis, Ph.D.
Department of American Studies, Plan II Honors Program
Second Reader

ABSTRACT

Author: Ariella R. Noorily

Title: Compulsory Vaccination in the United States: Ethics, Regulations, and Recommendations

Supervising Professor: Jason Upton, Ph.D.

Infectious diseases such as poliomyelitis, smallpox, and Hib used to pose a significant threat to the population of the United States. Thanks to the advent of vaccinations, many of these dangerous diseases have been almost or completely eradicated in America and around the world. However, as the rates of infectious diseases decrease, anti-vaccine sentiment becomes more popular. There are many reasons for parents to refuse to vaccinate their children, but vaccine hesitancy of any kind jeopardizes America's maintenance of immunity and health. Therefore, although personal autonomy is an important principle in a democratic society, the United States government has an ethical duty to enact vaccination policy in order to prevent outbreaks of disease and to ensure the safety of the population at large.

This thesis will explore the many ethical issues associated with a compulsory vaccination program in the United States. Based on research about the science of vaccines, reasons for vaccine hesitancy, current United States policy, and utilitarian philosophy, a set of guidelines for an effective vaccine mandate will be proposed. These guidelines consist of five main criteria, all of which vaccination policy must follow in order to be considered ethical. The thesis will conclude with recommendations for policy and programming to combat decreased immunization rates in the United States, for the present and the future.

TABLE OF CONTENTS

Introduction

Poliomyelitis terrorized the United States during the first half of the twentieth century. Although it is usually not a fatal virus, causing paralytic infection in only 1% of all cases,[1] polio was one of the most frightening diseases. It infected both rich and poor without warning, and there was no cure. Many understood that if it could cripple a man like Franklin D. Roosevelt, no one was safe.[2] So during the summer months, Americans lived in fear of the virus and took a wide variety of precautions in order to avoid it, even though the method of transmission was unclear. Public pools and movie theatres closed, and parents kept their children at home.[3] In his 1951 book entitled *Diet Prevents Polio*, Dr. Benjamin Sandler famously attributed the virus's pathogenicity to low blood glucose levels, caused by the sugar crash that children experienced shortly after consuming soda and ice cream (this is now popularly cited as an important statistical mistake because it ascribed causation to a correlational situation, i.e., that children ate more ice cream during polio season).[4,5] Unsurprisingly, ice cream sales plummeted after Sandler's theory spread.[6]

In 1952, America faced a polio epidemic that caused paralysis in 21,000 cases and death in over 3,000.[7,8] The country fell into a panic—on a list of the things Americans feared most,

---

[1] David M. Oshinsky, *Polio: An American Story* (Oxford: Oxford University Press, 2005), 8
[2] Ibid, 24
[3] "Healthline Presents: Polio Revisited," *Healthline* (YouTube, 2008), https://www.youtube.com/watch?v=4S8Qr6Zfv8E.
[4] Benjamin Pincus Sandler, *Diet Prevents Polio* (Lee Foundation for Nutritional Research, 1951).
[5] Steve Lohr, "For Today's Graduate, Just One Word: Statistics," *The New York Times*, August 5, 2009, http://www.nytimes.com/2009/08/06/technology/06stats.html.
[6] Wendy Moore, "Paralysed with Fear: The Story of Polio by Gareth Williams – Review," *The Guardian*, July 17, 2013, sec. Books, https://www.theguardian.com/books/2013/jul/17/paralysed-fear-polio-williams-review.
[7] "Poliomyelitis," in *Epidemiology and Prevention of Vaccine-Preventable Diseases*, 13th ed. (Atlanta: Centers for Disease Control and Prevention, 2015), 297–310, http://www.cdc.gov/VACCINes/pubs/pinkbook/downloads/hib.pdf.

polio came in second place, only after the fear of a nuclear attack.[9] Needless to say, when Jonas Salk announced the development of his polio vaccine in 1953, parents jumped at the opportunity to volunteer their children for the vaccine's medical field trial, which took place in 1954. It was the largest the world had ever seen: approximately two million children were injected with the vaccine.[10] Albert Sabin's live-attenuated polio vaccine was met with similar enthusiasm following its release a few years later.[11] Both scientists knew that their vaccines would change the world; when asked who owned the patent to his vaccine, Salk replied, "There is no patent. Could you patent the sun?"[12]

Just as Sabin and Salk believed, the advent of these vaccines was arguably one of the most important medical innovations of the century.[13] The vaccine allowed people to resume their normal activities and live without fear. Soon, polio was eradicated in the United States, and in 1988, the CDC undertook efforts to eradicate the disease worldwide—today, Pakistan, Nigeria, and Afghanistan remain the only three countries in which polio is endemic.[14] The World Health Organization estimates that because of the polio vaccine, eight million people who would otherwise have been crippled by this virus can walk today.[15] Through this strong focus on childhood vaccination efforts, a debilitating disease that had once seemed impossible to control is now on its way to total eradication.

---

[8] "Wiping Out Polio: How The U.S. Snuffed Out A Killer," *All Things Considered* (NPR, October 15, 2012).
[9] Moore, "Paralysed with Fear."
[10] Seth Mnookin, *The Panic Virus: A True Story of Medicine, Science, and Fear* (New York: Simon and Schuster, 2011), 43
[11] Stuart Blume and Ingrid Geesink, "A Brief History of Polio Vaccines," *Science* 288, no. 5471 (June 2, 2000): 1593–94, doi:10.1126/science.288.5471.1593.
[12] "Wiping Out Polio: How The U.S. Snuffed Out A Killer."
[13] Oshinsky, *Polio: An American Story*, 201
[14] "Polio Endemic Countries," *Global Polio Eradication Initiative*, 2017, http://polioeradication.org/.
[15] Matthew Janko, "Vaccination: A Victim of Its Own Success," *Virtual Mentor* 14, no. 1 (January 1, 2012): 3, doi:10.1001/virtualmentor.2012.14.1.fred1-1201.

Most Americans today are not familiar with polio. They have no memory of children immobilized in iron lungs or toddlers walking with crutches. They can only read about the sheer terror it provoked in the United States and the relief that swept the country after the release of the vaccines. The same sentiment applies for many other infectious diseases, including measles, pertussis, smallpox, mumps, tetanus, and diphtheria. Soon, many Americans will not remember the chickenpox either. The conquering of so many pathogens is a major achievement in medicine and public health.

However, this great achievement has a downside as well. For parents in the 1950's, the impetus to voluntarily vaccinate their children came from fear. For most parents in 2017, such fear no longer exists. Because vaccine-preventable diseases are out of sight, vaccines themselves do not seem to be worth the potential risks, minor and rare as they may be. Vaccine hesitancy—the feeling of uneasiness, complacency, or indignation regarding vaccinations—is spreading across the country and around the world. The refusal of many parents to vaccinate their children has led to recent outbreaks of disease across the globe. In March of 2017, measles outbreaks occurred in France, Germany, Italy, Poland, Romania, Switzerland, and Ukraine.[16] California had an outbreak as well in January of 2017.[17]

There are many reasons for anti-vaccination sentiment and vaccine refusal.[18] Some parents perceive vaccination as unnecessary because they do not view infectious diseases as a threat. Others resent the fact that vaccines are required by law, and decide not to vaccinate their children in opposition to government mandates. On the extreme end of the vaccine hesitancy

---

[16] "Measles Outbreak across Europe," *BBC News*, March 28, 2017, sec. Health, http://www.bbc.com/news/health-39419976.
[17] Soumya Karlamangla, "Measles Outbreak Grows in L.A.'s Orthodox Jewish Community despite California's Strict New Vaccination Law," *Los Angeles Times*, January 21, 2017, http://www.latimes.com/local/california/la-me-ln-measles-20170120-story.html.
[18] Eve Dubé et al., "Vaccine Hesitancy," *Human Vaccines & Immunotherapeutics* 9, no. 8 (August 8, 2013): 1763–73, doi:10.4161/hv.24657.

spectrum are anti-vaccine parents, who are vehemently against the administration of vaccines. Usually, these individuals believe that vaccines are dangerous (e.g., they believe that vaccines cause autism or other developmental disorders).[19] Then, there are parents who have nothing against vaccines, but struggle to vaccinate their children because of financial difficulties or an inability to regularly visit a pediatrician.

If Americans today were simply allowed to choose whether to vaccinate their children in an opt-in system, immunization rates would not be high enough to prevent outbreaks in the United States. For this reason, the government has chosen to enact compulsory vaccination laws. For the most part, these laws incentivize parents to vaccinate their children by linking school enrollment to vaccination status. For parents who do not wish to vaccinate their children, exemption forms exist, although the particulars of the exemption laws vary by state—some allow parents to opt out of vaccination for "personal beliefs," while others allow exemptions only in cases of medical necessity.

The United States government enacts such laws in order to prevent an infectious disease from terrorizing the country as polio did in 1952. These laws have other significant benefits as well. For example, vaccination programs in the United States save the government and individual patients billions of dollars in healthcare costs.[20] However, any law that is compulsory in nature strips personal liberties from citizens. America especially values the maintenance of freedom and liberty of choice, which is why compulsory vaccination raises several important ethical issues. With respect to a mandatory vaccination program in the United States, one must answer the following question: Is compulsory vaccination ethical in a democratic society, and

[19] Mnookin, *The Panic Virus: A True Story of Medicine, Science, and Fear*.
[20] Fangjun Zhou et al., "Economic Evaluation of the Routine Childhood Immunization Program in the United States, 2009," *Pediatrics* 133, no. 4 (April 1, 2014): 577–85, doi:10.1542/peds.2013-0698.

what is the best way to ensure the safety and health of the larger community without compromising personal autonomy?

The chapters to follow will attempt to answer this ethical question. Chapters two and three will give detailed explanations of vaccine science and safety, as well as an introduction to and explanation of the vaccine hesitant sentiment that is spreading worldwide. With this foundation in place, chapter four will review the ethics of mandatory immunization, from both governmental and individual viewpoints. Then, chapter five will explore the legal basis for such a program and will describe the laws that govern vaccination in America today. Finally, in chapter six, I will propose my recommendations for the United States in its attempt to create a society that is free of vaccine-preventable diseases, today and into the future.

Chapter 1

Vaccinations: Science, History, Benefits and Risks

Before coming to a conclusion about the ethical basis for government-mandated immunizations, it is important to explain foundational historic and scientific information. This chapter will provide a thorough background of vaccinations. First, the concept and process of immunization will be described so that the reader can continue through the paper with a complete understanding of the terms "vaccination" and "immunization." Then, the chapter will include a brief history of the development of vaccines and their progression over time. Finally, it will conclude with a discussion of the benefits and risks of vaccines, both on individual and community levels.

A vaccine is a pharmaceutical that activates the body's natural immune response, training it to prevent disease in the future. During the process of vaccination, an avirulent, non-toxic version or component of a pathogen is introduced into a human host. Soon after, the cells of the immune system recognize and respond to the foreign substance. The host creates antibodies that are designed to fit the pathogenic components, or antigens, like a lock-and-key in order to destroy them. The body then saves these antibodies to reproduce and use during future exposures to virulent viruses and bacteria, thereby stopping the progression of disease.[1] Therefore, a child who has received a chickenpox vaccine will have an immediate immune response to the chickenpox virus and will not develop symptoms. (Similar immunity develops when a child is actually infected with chickenpox; that is why no one can catch it twice.) This process of

[1] Patrick R. Murray, Ken S. Rosenthal, and Michael A. Pfaller, "Antimicrobial Vaccines," in *Medical Microbiology*, 5th ed. (Philadelphia: Elsevier Mosby, 2005), 159–66.

building up and maintaining an immune response to specific pathogenic antigens after vaccination is called immunization.[2]

Because no two pathogens are the same, there are several different types of vaccines. Each bacteria or virus necessitates the development of a certain type depending on both safety and efficacy. There are two major categories of vaccines: live and inactivated. A live-attenuated vaccine is one that contains whole, live organisms that do not have the ability to cause disease. These have been weakened and modified in the lab to become avirulent, but they remain so similar to the actual deadly pathogen that the immunization is more effective and longer lasting. However, they may still be dangerous to immunosuppressed patients and may be more difficult to store because they usually require refrigeration.[3] The vaccine for measles (part of the MMR vaccine) is live-attenuated and is one of the most effective vaccines used today.[4]

On the other side of the spectrum, there are inactivated vaccines, which introduce a viral or bacterial antigen into the host in order to elicit an immune response. A whole inactivated vaccine is formed by killing a microorganism using chemicals, heat, or radiation, and then introducing the entire avirulent version into the host. One example of this is the inactivated polio vaccine; unlike the oral polio vaccine, it uses killed viral particles and is a slightly safer method of immunization.[5]

Other types of inactivated vaccines include subunit and toxoid vaccines. Subunit vaccines use components from the surface of the pathogen, but not the entire pathogen itself, to elicit an

---

[2] Ibid.
[3] Ibid., 162
[4] "Duration of Live Measles Vaccine-Induced Immunity. : The Pediatric Infectious Disease Journal," *LWW*, accessed December 3, 2016, http://journals.lww.com/pidj/Fulltext/1990/02000/Duration_of_live_measles_vaccine_induced_immunity_.8.aspx.
[5] Shimizu H, "Inactivated poliovirus vaccine.," *Nihon rinsho. Japanese journal of clinical medicine* 69, no. 9 (2011 2011): 1604–8.

immune response. Because of safety concerns regarding the whole-cell pertussis vaccine in the 1990's, a subunit vaccine was developed. Today, this acellular pertussis vaccine is on the regular vaccination schedule for all children in the United States. However, since subunit vaccines cannot bolster the immune system as potently as whole-cell vaccines, the acellular pertussis vaccine is not as effective for long-term immunity.[6] Toxoid vaccines work differently. Many pathogens, including *Clostridium tetani* and *Corynebacterium diphtheriae*, cause disease by releasing toxins into the body. While most vaccines introduce elements of the pathogens themselves, toxoid vaccines introduce the toxins in inactivated forms in order to elicit an immune response. A toxoid vaccine trains the body to target these disease-causing toxins, not the microorganisms themselves. The vaccines for tetanus and diphtheria (which are administered together with acellular pertussis to form the DTaP vaccine) are both toxoid vaccines. Inactivated vaccines are slightly less effective but safer, and are used when the pathogen cannot be attenuated.[7]

Before reaching this level of precision, safety, and efficacy, vaccines progressed through many stages of development during different periods of human history. The first ever vaccinations were performed in China as early as the sixteenth century, with the practice of variolation. This immunized a patient against smallpox by inoculating him with the virus (using either fresh pus or killed pox) and producing a (usually) mild case of disease.[8] During the late eighteenth century Edward Jenner discovered that milkmaids who contracted cowpox could not be infected with smallpox, and that those who were artificially inoculated with the cowpox virus

[6] Roger Baxter et al., "Effectiveness of Pertussis Vaccines for Adolescents and Adults: Case-Control Study," *BMJ* 347 (July 17, 2013): f4249, doi:10.1136/bmj.f4249.
[7] Murray, Rosenthal, and Pfaller, "Antimicrobial Vaccines," 60.
[8] Stanley A. Plotkin, ed., *History of Vaccine Development* (New York: Springer, 2011). 6

also developed immunity to smallpox.[9] The Latin name for cowpox, *variolae vaccinae*, is the origin of the word "vaccine."[10]

Jenner's discovery was the beginning of the development of live-attenuated vaccines. This method advanced when Louis Pasteur managed to attenuate organisms in the lab almost a century later. During the nineteenth century, scientists began to inactivate whole bacteria, a development that led to the production of vaccines for typhoid, plague, and pertussis. The twentieth century was also an important time period for vaccinations, with discoveries leading to the development of toxoid vaccines and the innovation of viral cultivation *in vitro*. The ability to grow viral cultures allowed the production of several important vaccines, including those for polio, measles, mumps, varicella, and zoster.[11]

New advancements are made every day, and vaccinations continue to improve. Discoveries in genetic engineering and molecular biology are enabling the production of hybrid virus vaccines, which will allow for the safer administration of more infectious agents, and DNA vaccines, which will inoculate the host with a pathogenic gene and cause the body to develop an immune response to the encoded protein, all without exposure to the pathogen. The scientific community is hopeful that with such new technologies, it will be possible to develop vaccines against many more infectious agents than we have available today.[12]

Extensive resources have been devoted to the development of vaccines throughout history because the benefits of vaccines are numerous. The most obvious benefit is their ability to protect against infectious diseases, which are always harmful and oftentimes deadly. It is

[9] Ibid., 21
[10] Ibid., 14
[11] Ibid., 2
[12] Murray, Rosenthal, and Pfaller, "Antimicrobial Vaccines," 165.

estimated that every year vaccines prevent a total of six million deaths worldwide.[13] Smallpox, an infectious disease that decimated native populations in the Americas and led to millions of deaths throughout human history in almost every geographic region, has been completely eradicated worldwide.[14] This was possible because of a widespread vaccination campaign undertaken by the World Health Organization in 1966. By 1977, the world saw its last case of smallpox. Today, it is not necessary to vaccinate against smallpox because the virus no longer exists naturally.[15,16]

Smallpox eradication is the clearest example of the efficacy of vaccines as defenses against infectious diseases. However, similar stories and data exist for every pathogen against which we regularly vaccinate. For example, in the early 1980's, 20,000 children contracted *Haemophilus influenzae* type B (Hib) in the United States every year. The Hib bacteria can cause many different types of disease, including pneumonia, bacteremia, and meningitis. In fact, before it was vaccinated against, it was the leading cause of bacterial meningitis in children under the age of five. An average of 600 of these children died from this infection, and those that survived were still at risk for long-term complications, including deafness, neurological impairment, and blindness. Since the vaccine became widely available in 1987, Hib rates have declined more than 99% in the United States.[17]

---

[13] F. E. Andre et al., "Vaccination Greatly Reduces Disease, Disability, Death and Inequity Worldwide," *Bulletin of the World Health Organization* 86, no. 2 (February 2008): 140–46, doi:10.1590/S0042-96862008000200016.

[14] Stefan Riedel, "Edward Jenner and the History of Smallpox and Vaccination," *Baylor University Medical Center Proceedings* 18, no. 1 (2005): 21–25.

[15] "The Global Eradication of Smallpox: Final Report of the Global Commission for the Certification of Smallpox Eradication" (World Health Organization, December 1979).

[16] Smallpox could be eradicated because it has certain characteristics that other pathogens do not. For example, it only passes human to human and does not have an animal or environmental reservoir; this means that the last human case of smallpox was *the last* case. Compare this to poliomyelitis or the Plague, which both exist in the environment and can reappear after periods of apparent eradication.

[17] "Poliomyelitis," 2015.

Rates of many other vaccine-preventable diseases, including diphtheria, poliomyelitis, measles, mumps, pertussis, hepatitis A and B, and tetanus, have also displayed significant downward trends since their vaccinations first became available and recommended for use.[18] A comparison of different countries emphasizes this point very well. For example, according to the World Health Organization, the United States had 229 cases of mumps in 2012, while Japan had 71,549 (an improvement from 2010, when they had a reported 179,635 cases).[19] This difference can be attributed to the immunization programs of the countries; while the measles-mumps-rubella (MMR) vaccine is part of the regular schedule for all children in the United States, it is not a routine immunization for children in Japan.[20]

The second important benefit of vaccinations is that they create herd immunity, which is immunity for an entire community. When a sufficient percentage of the population is immune to a disease, those who are not immune will also be protected. This is because the transmission of an infectious disease will not be successful in a highly immunized population, where most people cannot become sick or spread the disease to unvaccinated individuals.[21] This concept is supported by a mathematical threshold theorem that uses the R_0 number of a disease (i.e., the reproduction rate, or the average number of transmissions from one case of disease) to calculate the percentage of the population that must be vaccinated in order to create herd immunity.[22] It

---

[18] Sandra W. Roush, Trudy V. Murphy, and and the Vaccine-Preventable Disease Table Working Group, "Historical Comparisons of Morbidity and Mortality for Vaccine-Preventable Diseases in the United States," *JAMA* 298, no. 18 (November 14, 2007): 2155–63, doi:10.1001/jama.298.18.2155.
[19] "WHO World Health Organization: Immunization, Vaccines And Biologicals. Vaccine Preventable Diseases Vaccines Monitoring System 2016 Global Summary Reference Time Series: MUMPS," accessed December 4, 2016, http://apps.who.int/immunization_monitoring/globalsummary/timeseries/tsincidencemumps.html.
[20] David McNeill, "Japan's National Immunisation Program Still Trails Europe," *Japan Today*, January 23, 2016, https://www.japantoday.com/category/health/view/japans-national-immunisation-program-still-trails-behind-europe.
[21] Andre et al., "Vaccination Greatly Reduces Disease, Disability, Death and Inequity Worldwide."
[22] Paul Fine, Ken Eames, and David L. Heymann, "'Herd Immunity': A Rough Guide," *Clinical Infectious Diseases* 52, no. 7 (April 1, 2011): 911–16, doi:10.1093/cid/cir007.

also depends on the efficacy of the vaccine itself; higher thresholds are required for vaccines that are less effective or for which immunity wanes over time. Therefore, every disease has a different threshold for herd immunity. For example, diphtheria has a threshold of 85% while pertussis has a threshold of 92-94%.[23]

Herd immunity is important because it can eliminate a disease even when the rate of vaccination is lower than 100%, and it protects those who are not vaccinated. There are many individuals in the population who fall into this category, such as newborn babies who have not yet received their vaccinations and individuals for whom vaccinations are dangerous. Medically contraindicated cases include patients who are allergic to vaccine components and patients who are immunocompromised (e.g., cancer and AIDS patients).[24] Thus, in order to ensure that these groups within society remain healthy, a threshold level of immunity must be reached.

Herd immunity is community-specific. This means that even when the entire country, state, or city meets a threshold of coverage, outbreaks can still occur if there are small communities that do not. For example, Los Angeles as a whole may meet the necessary coverage, but if small pockets of the city fall below the necessary threshold, they are at high risk for infectious disease. One case of measles in a tight-knit community with a 70% immunization rate will spread easily and rapidly. This is what makes small private schools with high rates of vaccine hesitancy so dangerous and high community levels of immunization so important.

The third important benefit of vaccinations is often overlooked. However, when one considers how miniscule the cost of a vaccine program is compared to the cost of treatment for infectious diseases, it becomes obvious. The economic and financial advantages of a regular

---

[23] Paul Fine, "Herd Immunity: History, Theory, Practice," *Epidemiologic Reviews* 15, no. 2 (1993): 265–302.

[24] "Vaccine Contraindications and Precautions Recommendations | CDC," *Centers for Disease Control and Prevention*, accessed November 20, 2016, http://www.cdc.gov/vaccines/hcp/admin/contraindications.html.

vaccination program are remarkable. According to a study of the economic impact of the United States immunization program in 2009, one year of childhood vaccinations will prevent forty-two thousand early deaths and twenty million cases of disease. Regular vaccinations in the United States save $20.3 billion per year in direct healthcare costs.[25] A review of a healthcare-associated measles outbreak in 2008 gives a more concrete example of this. When an unvaccinated and infected Swiss traveler visited a hospital in Tucson, Arizona, she caused a measles outbreak that infected fourteen people. Overall, the two hospitals involved spent almost $800,000 containing the disease outbreak.[26]

However, the cost of healthcare is not the only one incurred from infectious disease outbreaks. When employees miss work because of illness (their own or their children's) or have to permanently stop working because of disability caused by illness, there is a greater societal cost of infectious disease. In fact, the amount of money that the country saves through vaccinations rises to $76.4 billion when indirect societal costs are considered.[27] Today, the United States spends approximately $7.5 billion on its vaccination program, which means that it saves a net $69 billion each year.[28]

Some smaller-scale analyses demonstrate the indirect cost benefits of vaccinations very well. One study looked at the public health costs of a 2004 measles outbreak in Iowa. This considered the time that public health officials spent traveling, setting up clinics, quarantining patients, answering phone calls, and performing other tasks involved in the containment of the

[25] Zhou et al., "Economic Evaluation of the Routine Childhood Immunization Program in the United States, 2009."
[26] Sanny Y. Chen et al., "Health Care–Associated Measles Outbreak in the United States After an Importation: Challenges and Economic Impact," *Journal of Infectious Diseases* 203, no. 11 (June 1, 2011): 1517–25, doi:10.1093/infdis/jir115.
[27] Zhou et al., "Economic Evaluation of the Routine Childhood Immunization Program in the United States, 2009."
[28] Ibid.

outbreak. Overall, the cost was estimated to be $142,452.[29] Another 2004 study of Colombian bank employees measured the economic benefit of an influenza vaccine program from the company's point of view. In addition to recording absenteeism, this study measured the drop in employee efficiency for those who became sick and attended work with flu-like symptoms. They determined that an employee vaccination program was 68% effective, and that it saved the company a net $89 to $237 per vaccinated employee.[30]

While the benefits of vaccines are abundant, it is also important to consider the risks. Like any medical procedure, vaccines pose a number of risks and side effects, ranging from mild to severe. Examples of mild side effects include soreness or bruising at the site of injection, low-grade fever, and flu-like symptoms.[31] For some vaccines, including Gardasil, there is a risk of fainting after injection; because of this, patients are usually asked to wait in the doctor's office for fifteen minutes so that they can be monitored.[32]

In addition, someone who is allergic to a component of a vaccination can suffer from a reaction, which can be mild or serious. For example, the production of the influenza vaccine involves the use of eggs, and the vaccine itself can contain small amounts of egg protein. Therefore, this vaccine is contraindicated for individuals with egg allergies.[33] Some vaccines pose more severe risks as well. The MMR vaccine has been associated with a very low, albeit

---

[29] Gustavo H. Dayan et al., "The Cost of Containing One Case of Measles: The Economic Impact on the Public Health Infrastructure—Iowa, 2004," *Pediatrics* 116, no. 1 (July 1, 2005): e1–4, doi:10.1542/peds.2004-2512.
[30] Alvaro Morales et al., "Costs and Benefits of Influenza Vaccination and Work Productivity in a Colombian Company from the Employer's Perspective," *Value in Health* 7, no. 4 (July 1, 2004): 433–41, doi:10.1111/j.1524-4733.2004.74006.x.
[31] "Possible Side Effects from Vaccines," *Centers for Disease Control and Prevention*, accessed December 4, 2016, http://www.cdc.gov/vaccines/vac-gen/side-effects.htm#flu.
[32] "Side Effects of GARDASIL®9 (Human Papillomavirus 9-Valent Vaccine, Recombinant)," accessed December 4, 2016, https://www.gardasil9.com/about-gardasil9/side-effects-and-safety/.
[33] "How Influenza (Flu) Vaccines Are Made | Seasonal Influenza (Flu) | CDC," *Centers for Disease Control and Prevention*, accessed December 4, 2016, http://www.cdc.gov/flu/protect/vaccine/how-fluvaccine-made.htm.

increased, risk of febrile seizures for one to two weeks following vaccination. The whole-cell pertussis vaccine was also associated with febrile seizures, which is one of the reasons that the new acellular pertussis vaccination was developed.[34]

The Sabin oral polio vaccine (OPV) poses another serious vaccine-related risk. Unlike the Salk inactivated polio vaccine, the OPV uses a live-attenuated virus that is administered orally in order to induce immunity. The attenuated viral particles pass through the host in the same way that the wild-type virus does. In the vast majority of cases, no disease occurs and lifelong immunity develops. However, in very rare cases, the attenuated virus can mutate into a virulent form during its passage through the body. This active virus can either cause mild illness in the host or enter the nervous system to cause paralysis. The virulent form can also be spread to others who are not immune. Outbreaks of vaccine-associated paralytic poliomyelitis (VAPP) are unlikely, but do occur throughout the world. However, the United States and many other developed countries now exclusively use the Salk inactivated polio vaccine, which poses no such risks. [35]

Vaccinations have become a significant part of both local and global public health systems. An understanding of the different types of vaccines as well as their methods of action, origins, development, and medical implications can help form a foundation of knowledge that is important in the determination of certain public health factors. With the information described in this chapter, it is possible to begin a discussion of barriers to herd immunity in the United States today and the ethical basis of compulsory vaccination.

---

[34] William E. Barlow et al., "The Risk of Seizures after Receipt of Whole-Cell Pertussis or Measles, Mumps, and Rubella Vaccine," *New England Journal of Medicine* 345, no. 9 (August 30, 2001): 656–61, doi:10.1056/NEJMoa003077.

[35] Aamir Shahzad, "Time for a Worldwide Shift from Oral Polio Vaccine to Inactivated Polio Vaccine," *Clinical Infectious Diseases* 49, no. 8 (October 15, 2009): 1287–88, doi:10.1086/605691.

Chapter 2

Vaccine Hesitancy: Causes and Effects

Despite the advantages of having a fully immunized population, rates of vaccination in the United States are not one hundred percent. There are several reasons for this. First, individuals who cannot safely receive vaccinations (namely, immunocompromised patients and infants who have not reached the age that the vaccine schedule recommends) go unimmunized and decrease the coverage of the population. Second, although the healthcare system allows for children of low-income families to receive vaccinations at no cost through the federally funded Vaccines for Children (VFC) program, there are children in this group who do not visit a pediatrician frequently enough to receive regular vaccinations.[1] There are also parents who simply do not understand the recommended schedule well enough to know when to bring their children to the doctor.[2]

The third main reason for a decreased immunization rate is vaccine hesitancy, which can result in full vaccine exemptions or delays, both of which are harmful to public health. Vaccine hesitant individuals are those who are uneasy or skeptical about vaccinations in some way, although the degree of and reason for hesitancy varies greatly from person to person. On one end of the spectrum, there are parents who avoid vaccinations simply because they do not want to see their children crying or in pain, not because they think the vaccines themselves are harmful.[3]

---

[1] Holly Hill et al., "National, State, and Selected Local Area Vaccination Coverage Among Children Aged 19–35 Months — United States, 2014," *Morbidity and Mortality Weekly Report* 64, no. 33 (August 28, 2015): 889–96.
[2] Karlen E. Luthy, Renea L. Beckstrand, and Neil E. Peterson, "Parental Hesitation as a Factor in Delayed Childhood Immunization," *Journal of Pediatric Health Care: Official Publication of National Association of Pediatric Nurse Associates & Practitioners* 23, no. 6 (December 2009): 388–93, doi:10.1016/j.pedhc.2008.09.006.
[3] Ibid.

Other parents may only wish to delay the vaccine schedule to give their children more time in between shots, and some may choose to opt out of only certain specific vaccines. On the other extreme of the spectrum are parents who adamantly refuse the administration of all vaccines, even going as far as homeschooling their children to evade governmental vaccination laws—these parents are popularly called "anti-vaxxers."

Interestingly enough, the anti-vaccine community is largely made of white, college educated, upper class individuals.[4] This is perhaps because such individuals appreciate the opportunity to research issues themselves before making important decisions, especially when those decisions involve healthcare; the problem arises when they find their information from Internet sources that encourage vaccine hesitancy, instead of peer-reviewed scientific journals.[5] These communities also tend to be very liberal-minded, which can motivate some to be anti-vaccine on a "go green" platform that supports alternative, natural remedies to illness and questions the use of vaccinations. In 2014, *The Atlantic* published an article entitled "Wealthy L.A. Schools' Vaccination Rates are as Low as South Sudan's," a headline that highlights just how strongly anti-vaccine these communities can be.[6]

American parents can apply for vaccine exemptions based on religious views or personal beliefs, although these vaccine-specific laws are decided by state; currently, forty-seven states

[4] Mariam Siddiqui, Daniel A Salmon, and Saad B Omer, "Epidemiology of Vaccine Hesitancy in the United States," *Human Vaccines & Immunotherapeutics* 9, no. 12 (December 1, 2013): 2643–48, doi:10.4161/hv.27243.
[5] Anna Kata, "Anti-Vaccine Activists, Web 2.0, and the Postmodern Paradigm – An Overview of Tactics and Tropes Used Online by the Anti-Vaccination Movement," *Vaccine*, Special Issue: The Role of Internet Use in Vaccination Decisions, 30, no. 25 (May 28, 2012): 3778–89, doi:10.1016/j.vaccine.2011.11.112.
[6] Olga Khazan, "Wealthy L.A. Schools' Vaccination Rates Are as Low as South Sudan's," *The Atlantic*, September 16, 2014, https://www.theatlantic.com/health/archive/2014/09/wealthy-la-schools-vaccination-rates-are-as-low-as-south-sudans/380252/.

(all except for Mississippi, West Virginia, and California) allow for religious exemptions,[7] and eighteen allow for both religious and personal belief exemptions.[8] California only recently tightened its vaccine legislation with Senate Bill 277, which was approved in 2015 following the measles outbreak at Disneyland, a recent consequence of increased vaccine hesitancy that will be discussed in more detail later in this chapter.[9]

The allowance for vaccine exemptions on religious grounds is meant to protect the first amendment and freedom of religion. Of course, every religion has a different perspective on vaccination that is specific to its doctrine. For example, the religion of Jainism focuses on the value of all life. For Jains, this value extends even to the bacteria that are killed in order to produce vaccines. Thus, vaccinations can be considered forbidden in Jainism. However, many Jains today recognize that small life must be sacrificed for the continuation of life altogether, and therefore comply with vaccination schedules.[10] Catholicism may take issue with vaccines that use cell lines from aborted fetuses in their production, and Islam and Judaism could be interpreted to disallow vaccines with porcine or gelatin elements.[11]

However, in the large majority of these cases, the religious value of human life and the recognition of vaccination as a life-saving measure takes precedence, and vaccines are widely accepted by most religions. In fact, for some religious communities, complying with regular vaccines schedules has become as important as many other religious laws. The Jewish

---

[7] The laws in Minnesota and Louisiana do not explicitly recognize religion as a reason for exemption, but allow for it to fall under the "personal belief" category.
[8] "States With Religious and Philosophical Exemptions From School Immunization Requirements," *National Conference of State Legislatures*, August 23, 2016, http://www.ncsl.org/research/health/school-immunization-exemption-state-laws.aspx.
[9] "SB-277 Public Health: Vaccinations.," *California Legislative Information*, 2015, https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB277.
[10] John D. Grabenstein, "What the World's Religions Teach, Applied to Vaccines and Immune Globulins," *Vaccine* 31, no. 16 (April 12, 2013): 2011–23, doi:10.1016/j.vaccine.2013.02.026.
[11] Ibid.

community began its discussion of vaccines during the popularization of the smallpox inoculation. There was a question of whether it was allowed for a physician to perform a procedure on a healthy person to prevent illness in the future. Despite the known risks of vaccines, rabbis advocated their use, even going so far as to allow inoculation on the Sabbath (if absolutely necessary), thus equating the importance of vaccination to the emergent treatment of life-threatening illness.[12]

The community that is perhaps most famous for vaccine rejection is the Amish. Their vaccination practices have been publicized by reports of several infectious disease outbreaks in Amish communities. An outbreak of pertussis infected 345 people in an Amish community in Kent County, Delaware in 2004.[13] In 2014, two Amish men returned from the Philippines carrying the measles virus, resulting in an outbreak in Knox County, Ohio, which eventually involved 383 cases; 89% of these patients were unvaccinated.[14]

However, contrary to popular belief, vaccination is not prohibited by the Amish religious doctrine. Rather, immunization acceptance varies from community to community and is based on ideological rather than theological beliefs. A rejection of modernity and the lack of scientific knowledge available contribute to low levels of immunization in Amish communities.[15] In addition, just like in many other communities, the Amish reject vaccinations because of their side effects. In a 2011 study on Ohio's underimmunized Amish community, researchers found that 86% of Amish parents who completely opted out of vaccinations for their children did so out of

---

[12] Edward Reichman, "Halachic Aspects of Vaccinations" (Bikur Cholim, February 19, 2012), www.bikurcholim.net.
[13] Centers for Disease Control and Prevention (CDC), "Pertussis Outbreak in an Amish Community--Kent County, Delaware, September 2004-February 2005," *MMWR. Morbidity and Mortality Weekly Report* 55, no. 30 (August 4, 2006): 817–21.
[14] Paul A. Gastañaduy et al., "A Measles Outbreak in an Underimmunized Amish Community in Ohio," *New England Journal of Medicine* 375, no. 14 (October 6, 2016): 1343–54, doi:10.1056/NEJMoa1602295.
[15] Grabenstein, "What the World's Religions Teach, Applied to Vaccines and Immune Globulins."

fear of adverse effects.[16] Regardless of the reason, Amish communities continue to have higher than average rates of vaccine refusal, and they take full advantage of the exemptions offered by their home states. In 2012, Mennonite and Amish schools in New York had an average religious exemption rate of 61.5%.[17]

The personal belief exemption is more difficult to understand because it encompasses so many different viewpoints and such a broad spectrum of beliefs about vaccines. Most vaccine hesitant individuals subscribe to a personal or ideological belief that is not religious in origin, even within very religious communities. The recent measles outbreak in Los Angeles reflects this point very well. In January 2017, at least eighteen individuals from the Orthodox Jewish community contracted measles, and none of them could provide proof of immunization.[18] According to Rabbi Hershy Ten, director of L.A.'s Jewish healthcare organization Bikur Cholim, it was popular pseudo-scientific theories and other personal beliefs that motivated these families to refuse vaccination and to break down the herd immunity of their community—Jewish law had nothing to do with their decisions. In order to prevent a similar event in the future, Rabbi Ten hosted a teleconference with community members, healthcare professionals, and seventy Jewish private school principals to discuss the importance of vaccinations.[19]

Many of the personal beliefs that result in vaccine hesitancy are formed through false, pseudo-scientific information presented in the media, made more readily available in recent

[16] Olivia K. Wenger et al., "Underimmunization in Ohio's Amish: Parental Fears Are a Greater Obstacle Than Access to Care," *Pediatrics*, June 22, 2011, peds.2009-2599, doi:10.1542/peds.2009-2599.
[17] Yun-Kuang Lai et al., "Variation in Exemptions to School Immunization Requirements among New York State Private and Public Schools," *Vaccine; Kidlington* 32, no. 52 (December 12, 2014): 7070–76, doi:http://dx.doi.org.ezproxy.lib.utexas.edu/10.1016/j.vaccine.2014.10.077.
[18] Karlamangla, "Measles Outbreak Grows in L.A.'s Orthodox Jewish Community despite California's Strict New Vaccination Law."
[19] Rabbi Hershy Ten, in discussion with author, February 1, 2017.

years by the Internet.[20] One of the best examples of this today is the connection of vaccines to autism. In 1998, the *Lancet* published an article by Andrew Wakefield that linked the development of autism to the MMR vaccine and other thimerosal-containing vaccines. It is true that the onset of autism can often coincide with the scheduled MMR vaccination because both happen to occur during early childhood.[21] However, this relationship is correlational, not causational. Several studies conducted after 1998 have proven that there is no causal link between the MMR vaccine or other thimerosal-containing vaccines and autism.[22] Still, thimerosal was removed from all childhood vaccines in the U.S. in 2001, a decision that was made to appease nervous parents but did not lower the incidence of autism in the country.[23] Wakefield's study was later found to be fraudulent because the researchers cited falsified data and facts; in 2010, the article was retracted[24] and Wakefield was stripped of his medical license.[25]

However, many members of the vaccine hesitant movement still believe in this theory, and it continues to be one of the main arguments they use to substantiate their views. The question is how such a significant number of parents became convinced of the vaccine-autism link, and how this community can so adamantly stand up for a belief that, according to scientific evidence, is false. In his book entitled *The Panic Virus*, Seth Mnookin aims to answer this

---

[20] Anna Kata, "A Postmodern Pandora's Box: Anti-Vaccination Misinformation on the Internet," *Vaccine* 28, no. 7 (February 17, 2010): 1709–16, doi:10.1016/j.vaccine.2009.12.022.
[21] T. S. Sathyanarayana Rao and Chittaranjan Andrade, "The MMR Vaccine and Autism: Sensation, Refutation, Retraction, and Fraud," *Indian Journal of Psychiatry* 53, no. 2 (2011): 95–96, doi:10.4103/0019-5545.82529.
[22] Paul Stehr-Green et al., "Autism and Thimerosal-Containing Vaccines: Lack of Consistent Evidence for an Association," *American Journal of Preventive Medicine* 25, no. 2 (August 2003): 101–6, doi:10.1016/S0749-3797(03)00113-2.
[23] "Thimerosal in Vaccines," *Centers for Disease Control and Prevention*, August 27, 2015, https://www.cdc.gov/vaccinesafety/concerns/thimerosal/.
[24] Laura Eggertson, "Lancet Retracts 12-Year-Old Article Linking Autism to MMR Vaccines," *Canadian Medical Association Journal* 182, no. 4 (March 9, 2010): E199–200, doi:10.1503/cmaj.109-3179.
[25] Alice Park, "Doctor behind Vaccine-Autism Link Loses License," *Time*, accessed February 6, 2017, http://healthland.time.com/2010/05/24/doctor-behind-vaccine-autism-link-loses-license/.

question. He concludes that many parents of children with autism or other developmental disorders feel helpless, guilty, and angry, and they are looking to assign fault. The network of support created when thousands of these parents come together is very strong, and it is amplified when they can rally behind one belief. Unfortunately, this belief is that the cause of their children's disabilities is clearly and simply vaccination. With an issue that is so emotionally charged, it is difficult for individuals to make decisions based on logic and evidence.[26] In this case, science cannot argue with feeling, which is why the vaccine-autism link has been so critical in propelling the anti-vaccine movement forward.

The support that many celebrities lend to the cause adds validity to this theory as well. Jenny McCarthy is one of the most vocal advocates of the MMR-autism link, and her strong opinions come from her personal experiences with her son Evan, who was diagnosed with autism shortly after receiving the vaccine.[27] Robert De Niro rallies behind this cause for the same reason. His views entered the spotlight during the 2016 Tribeca Film Festival, when he advocated for the showing of Andrew Wakefield's anti-vaccine documentary "Vaxxed: From Cover-Up to Catastrophe," and then pulled it from the lineup in response to backlash.[28] The "Vaxxed" film and merchandise are sold on their website, which also provides resources for interested individuals to learn more about the cause and contact representatives.[29]

---

[26] Seth Mnookin, *The Panic Virus: A True Story of Medicine, Science, and Fear* (New York: Simon and Schuster, 2011), 18

[27] "Jenny McCarthy: 'We're Not An Anti-Vaccine Movement ... We're Pro-Safe Vaccine,'" *FRONTLINE*, accessed February 6, 2017, http://www.pbs.org/wgbh/frontline/article/jenny-mccarthy-were-not-an-anti-vaccine-movement-were-pro-safe-vaccine/.

[28] Katie Van Syckle and Katie Van Syckle, "Tribeca Film Festival Pre-Party: Filmmakers Weigh in on 'Vaxxed' Controversy," *Variety*, April 13, 2016, http://variety.com/2016/film/news/tribeca-film-festival-2016-filmmaker-party-vaxxed-1201752508/.

[29] "Vaxxed: From Cover-Up to Catastrophe Official Website," *Vaxxed*, accessed February 7, 2017, http://vaxxedthemovie.com/.

Robert F. Kennedy, Jr. has also significantly contributed to this movement, even going as far as comparing the effects of mandatory vaccines to a holocaust (a remark for which he later apologized).[30] In 2005, Rolling Stone and Salon.com co-published his article, entitled "Deadly Immunity," which claimed that the government and pharmaceutical industry decided to cover up the data suggesting that thimerosal-containing vaccines may cause autism and other neurological disorders in children.[31] In the days following publication, several amendments were made to the story. Although it is still available online in Rolling Stone's archives, Salon.com deleted the piece from its website in 2011, in accordance with what it believed to be the "best reader service."[32] Kennedy and his anti-vaccine views recently reentered the spotlight when President Donald Trump, also a self-proclaimed vaccine skeptic, reportedly asked him to chair a new commission on the safety of vaccines,[33] despite the fact that the Advisory Commission for Immunization Practices was established fifty years ago[34] (the Trump administration quickly denied that they had appointed Kennedy to this role, claiming that no decision had been reached).[35]

Kennedy's article did not just increase vaccine hesitancy by convincing parents that vaccines could cause autism; it led many people to feel distrustful of government and big

---

[30] "ADL Slams RFK Jr. for Vaccines-Holocaust Analogy," *Jewish Telegraphic Agency*, April 14, 2015, http://www.jta.org/2015/04/14/news-opinion/united-states/adl-slams-rfk-jr-for-vaccines-holocaust-analogy.
[31] Robert F. Kennedy, "Deadly Immunity," *Rolling Stone; New York*, July 30, 2005.
[32] Kerry Lauerman, "Correcting Our Record," *Salon*, accessed February 8, 2017, http://www.salon.com/2011/01/16/dangerous_immunity/.
[33] Alex Berezow and Hank Campbell, "Ignore Anti-Vaccine Hysteria, Mr. Trump," *Wall Street Journal*, January 11, 2017, sec. Opinion, http://www.wsj.com/articles/ignore-anti-vaccine-hysteria-mr-trump-1484093196.
[34] Lena Sun, "The United States Already Has a Vaccine Safety Commission. And It Works Really Well, Experts Say.," *Washington Post*, January 13, 2017, https://www.washingtonpost.com/news/to-your-health/wp/2017/01/13/the-u-s-already-has-a-vaccine-safety-commission-and-it-works-really-well-experts-say/.
[35] Peggy Peck, "Trump Denies Naming Vax Skeptic to Safety Panel," January 10, 2017, http://www.medpagetoday.com/InfectiousDisease/Vaccines/62452.

pharmacy, which is another reason many parents cite for refusing vaccinations.[36,37] Therefore, when the government or the CDC releases research that debunks the MMR-autism link, many simply do not believe it. Parents today also wish to be more involved in their healthcare decisions than they have been in the past, so government-mandated medical procedures of any kind can make many feel that their medical autonomy is being threatened.[38] In addition, people seem to be more protective over their healthcare rights than they are over other personal decisions. For example, most individuals do not argue against the government for mandating that they have a driver's license and car insurance before driving a car, but many are vehemently against the Affordable Care Act because it forces all Americans to have health insurance and penalizes them if they do not.[39] For some, vaccine refusal is perhaps a result of distrust in governmental healthcare policy specifically rather than a distrust in government as a whole.

Political views also influence vaccine choice for those who believe the government should stay out of its citizens' personal lives, regardless of the issue. For example, many staunchly libertarian individuals feel strongly about maintaining their power to choose. In August 2016, "The Libertarian Reporter" published an article criticizing libertarian presidential candidate Gary Johnson for reversing his pro-choice view on vaccinations.[40] In general, those

---

[36] Siddiqui, Salmon, and Omer, "Epidemiology of Vaccine Hesitancy in the United States."
[37] Charlotte Lee et al., "Hurdles to Herd Immunity: Distrust of Government and Vaccine Refusal in the US, 2002-2003," *Vaccine* 34, no. 34 (July 25, 2016): 3972–78, doi:10.1016/j.vaccine.2016.06.048.
[38] Louis Z. Cooper, Heidi J. Larson, and Samuel L. Katz, "Protecting Public Trust in Immunization," *Pediatrics* 122, no. 1 (July 1, 2008): 149–53, doi:10.1542/peds.2008-0987.
[39] Tami Luhby, "Why so Many People Hate Obamacare," *CNN Money*, January 5, 2017, http://money.cnn.com/2017/01/05/news/economy/why-people-hate-obamacare/index.html.
[40] Aya Katz, "Gary Johnson Alters Position: Now Supports Mandatory Vaccination," *The Libertarian Republic*, August 25, 2016, http://thelibertarianrepublic.com/johnson-reverses-vaccination/.

who identify with such political ideology feel that "the state shouldn't play parent,"[41] and this most definitely includes the decision about vaccinations for children.

There are also vaccine hesitant individuals who identify with the "too many too soon" viewpoint, which claims that vaccines are fine, but not when given to very young children or in conjugation with one another, as the recommended schedule dictates. The belief is that these vaccines can overwhelm a child's immune system and lead to devastating side effects,[42] including the most popular fear: autism. In reality, a child's immune system faces many more pathogens from the natural environment than it does from the shots at a doctor's visit, and it has a sufficient capacity to handle them.[43]

Research also demonstrates that the recommended schedule is the safest and most successful,[44] effectively immunizing children before they ever have a chance to be exposed to the infectious disease and allowing parents to vaccinate their children in fewer trips to the doctor (convenience is an important aspect of vaccine compliance).[45] In addition, some pairings actually increase the success of the administered vaccines, which is why they are given together. For example, the antibody response to the tetanus vaccine is increased when it is given as part of the DTaP shot, and the immune response to varicella is improved when it is administered with the hepatitis B vaccine, as opposed to after.[46]

---

[41] Robby Soave, "Forget the Anti-Vaxxers: Libertarian Parenting Is Perfectly Healthy," *Reason.com*, February 6, 2015, http://reason.com/blog/2015/02/06/forget-the-anti-vaxxers-libertarian-pare.
[42] Paul A. Offit et al., "Addressing Parents' Concerns: Do Multiple Vaccines Overwhelm or Weaken the Infant's Immune System?," *Pediatrics* 109, no. 1 (January 1, 2002): 124–29, doi:10.1542/peds.109.1.124.
[43] Ibid.
[44] "Multiple Vaccines and the Immune System Concerns," *Centers for Disease Control and Prevention*, August 7, 2016, https://www.cdc.gov/vaccinesafety/concerns/multiple-vaccines-immunity.html.
[45] Paul A. Offit and Charlotte A. Moser, "The Problem With Dr Bob's Alternative Vaccine Schedule," *Pediatrics* 123, no. 1 (January 1, 2009): e164–69, doi:10.1542/peds.2008-2189.
[46] Dennis Conrad, M.D. (pediatric infectious disease specialist) in discussion with the author, January 6, 2017.

Still, this attitude has recently been popularized in the political arena with endorsements from President Donald Trump and board-certified physicians Rand Paul and Ben Carson during the Republican primaries in 2015.[47] Trump has shared his "too many too soon" views on twitter for several years now, with messages such as "massive combined inoculations to small children is the cause for increase in autism"[48] and "healthy young child goes to doctor, gets pumped with massive shot of many vaccines, doesn't feel good and changes—AUTISM. Many such cases!"[49] The second received almost 11,000 retweets, although Trump could never provide examples of "such cases."

Similar to the vaccine-autism link that is supporting the anti-vaccine movement today, other popular pseudo-scientific theories have gained leverage and threatened public health efforts in the past. The strong conservative response to sex education in schools is one example of this. Following World War I, from which many soldiers returned with venereal disease, reformers began working to put sex education in schools, although it started on a small scale.[50] Then, during the sexual revolution of the 1960's, the substantial increase in pre-marital pregnancy and the transmission of STDs[51] prompted more schools to implement sex education programs into their curricula. By 1968, almost half of all schools were teaching students about sex.[52]

---

[47] Arthur Allen, "Vaccine Phobia Infects GOP Race," *POLITICO*, accessed January 28, 2017, http://politi.co/1gvKDLP.
[48] Colin Daileda, "Donald Trump's Long History of Troubling Statements about Vaccines and Autism," *Mashable*, January 10, 2017, http://mashable.com/2017/01/10/donald-trump-vaccines-autism/.
[49] Donald J. Trump, "Healthy Young Child Goes to Doctor, Gets Pumped with Massive Shot of Many Vaccines, Doesn't Feel Good and Changes - AUTISM. Many Such Cases!," microblog, *@realdonaldtrump*, accessed February 9, 2017, https://twitter.com/realdonaldtrump/status/449525268529815552?lang=en.
[50] Jeffrey P. Moran, *Teaching Sex: The Shaping of Adolescence in the 20th Century* (Cambridge, Massacusetts: Harvard University Press, 2000), 98.
[51] Sadja Goldsmith, "San Francisco's Teen Clinic: Meeting the Sex Educaiton and Birth Control Needs of the Sexually Active Schoolgirl," *Family Planning Perspectives* 1, no. 2 (October 1969): 23–26.
[52] Moran, *Teaching Sex: The Shaping of Adolescence in the 20th Century,* 170.

Although it is proven that educating adolescents about sex reduces rates of STDs and pre-marital pregnancy significantly more than abstinence-only education,[53] and that sex education is not associated with an increased rate of sexual activity among adolescents,[54] these programs received a lot of backlash because of the belief that teaching sex encourages sex (a belief that is still common today). In the 1960's specifically, pseudo-factual accounts of sex-ed gone wrong fed anti-sexual education sentiment within the conservative community. Among these accounts include stories of teachers taking their clothes off in their classrooms, over-excited male students raping a female teacher, and teachers encouraging their students to explore with each other sexually in dark closets.[55] Needless to say, these stories contributed to a panic that hindered the progression of a successful and beneficial adolescent sex education program for much of America's history. Then, like today, public health efforts were thwarted by popular views in the media and misdirected concern about the wellbeing of America's children. This demonstrates the persuasive power of the unsupported anecdote among impressionable populations, and gives a historical parallel to the anti-vax movement and its "many such cases" of vaccine-caused autism.

While the vaccine hesitant population is made up of many parents who are nervous about potential risks and side effects, other individuals are vaccine hesitant for cultural reasons. Backlash against the Human Papillomavirus (HPV) vaccine called Gardasil, which was released in 2006, is a perfect example of this. HPV is so common that most sexually active individuals will contract it at some point in their lives. Many infections resolve without symptoms, but certain strains of the virus can cause several different types of cancer (most notably cervical, but

---

[53] F F Furstenberg, K A Moore, and J L Peterson, "Sex Education and Sexual Experience among Adolescents.," *American Journal of Public Health* 75, no. 11 (November 1, 1985): 1331–32, doi:10.2105/AJPH.75.11.1331.

[54] Pamela K. Kohler, Lisa E. Manhart, and William E. Lafferty, "Abstinence-Only and Comprehensive Sex Education and the Initiation of Sexual Activity and Teen Pregnancy," *Journal of Adolescent Health* 42, no. 4 (April 1, 2008): 344–51, doi:10.1016/j.jadohealth.2007.08.026.

[55] Moran, *Teaching Sex: The Shaping of Adolescence in the 20th Century,* 181.

also anal, vaginal, and oropharyngal),[56] which is why the Gardasil vaccine is such an important advancement in health for both women and men. However, because HPV is sexually transmitted, many parents are averse to vaccinating their children when they are young. The CDC recommends that it be administered at age 11 or 12,[57] and many parents see it as an unnecessary risk for their children, who are most likely not sexually active at this stage in life.[58] To parents of boys, for whom the risk of HPV-related cancers is significantly lower, the vaccine seems even more unreasonable. However, it is hard for a parent to know or accept when a child becomes sexually active, and therefore many young adults may contract HPV before their parents take them to get the vaccine.

One of the greatest fears that parents have about the Gardasil vaccine is that it will *incentivize* sexual activity and promiscuity in their children—similar to the fears surrounding birth control and sexual education.[59] This seems to be a cultural phenomenon, affecting mostly conservative and/or religious parents. In 2007, Texas Republicans were appalled when Governor Rick Perry ordered that young girls be vaccinated against the cancer-causing virus. When his executive order was overridden, Perry withheld his veto and eventually reversed his public views on the issue in preparation for the 2012 GOP presidential race.[60] Several years later, the acceptance of this vaccine in American society still has a long way to go; today, an average of

[56] "HPV Vaccine Information For Young Women," *Centers for Disease Control and Prevention*, accessed February 9, 2017, https://www.cdc.gov/std/hpv/stdfact-hpv-vaccine-young-women.htm.
[57] Ibid.
[58] Electra Paskett, "We Have a Vaccine for Six Cancers, so Why Are Less than Half of Kids Getting It?," *The Conversation*, February 6, 2017, http://theconversation.com/us.
[59] Ibid.
[60] Dan Eggen, "Rick Perry Reverses Himself, Calls HPV Vaccine Mandate a 'mistake,'" *Washington Post*, accessed February 9, 2017, https://www.washingtonpost.com/politics/rick-perry-reverses-himself-calls-hpv-vaccine-mandate-a-mistake/2011/08/16/gIQAM2azJJ_story.html.

63% of girls and 50% of boys in the U.S. have received one or more doses of Gardasil,[61] and only three jurisdictions require girls to receive the HPV vaccine for school enrollment: Rhode Island, D.C., and Virginia.[62]

In recent years, vaccine refusal has only become easier for parents because of a shift in the doctor-patient relationship and healthcare in general. Before medical information became widely available on the Internet, patients relied on their physicians' expertise and opinions to make healthcare choices. A pediatrician could discuss childhood vaccines with his patients, who were less skeptical about the procedure in the first place. Now, parents do not completely trust their doctors' recommendations and want more of a role in the decision-making process. At the same time, doctors have less time to interact with each patient, making it more difficult for them to explain the information that parents need in order to make educated decisions.[63]

Another reason vaccine hesitancy is on the rise is because of so-called "complacent" parents, who see the threat of infectious diseases as insignificant and therefore do not think vaccines are necessary.[64] Over time, vaccines have become victims of their own success; because they have lowered the incidence of infectious diseases so considerably, many people have forgotten why they are important. For those who lived during a time when polio, smallpox, and measles were common dangers, there was no debate over whether to immunize when these vaccines became available. However, for the current generation of new parents, the small risks

---

[61] "HPV Vaccine Coverage Maps – Infographic," *Centers for Disease Control and Prevention*, August 25, 2016, https://www.cdc.gov/hpv/infographics/vacc-coverage.html#text.
[62] "HPV Vaccine: State Legislation and Statutes," *National Conference of State Legislatures*, accessed February 9, 2017, http://www.ncsl.org/research/health/hpv-vaccine-state-legislation-and-statutes.aspx.
[63] Siddiqui, Salmon, and Omer, "Epidemiology of Vaccine Hesitancy in the United States."
[64] Cornelia Betsch, Robert Bohm, and Gretchen B. Chapman, "Using Behavioral Insights to Increase Vaccination Policy Effectiveness," *Policy Insights from the Behavioral and Brain Sciences* 2, no. 1 (2015): 61–73, doi:10.1177/2372732215600716.

that vaccines pose seem higher than any risk of disease.[65] Sometimes, an outbreak must occur simply to remind people of their necessity—it is likely that many Americans will voluntarily line up to receive a Zika vaccine as soon as it is developed,[66] just as they did for the H1N1 flu vaccine in 2009.[67]

Vaccine hesitancy is alive and well in the United States and much of the developed world, and the power of the anti-vax movement—including its false hypotheses about autism and its governmental conspiracy theories—is growing. The question, then, is whether it matters. The best way to answer this question is to review what happens when parents stop vaccinating their children. As one might predict, infectious diseases return to previously immunized societies.

In the 1980's, Sweden had an outbreak of pertussis. Following strong anti-vaccine sentiment regarding the whole-cell pertussis vaccine in the 1970's, the vaccine was made optional in 1979.[68] After a few years, the effects of this choice became clear; in 1985, 10,839 cases of pertussis were reported in Sweden.[69] These results are particularly interesting when they are compared to pertussis rates in Sweden's neighboring country of Norway during the same period of time. In 1974, pertussis rates were about the same in both countries. While Sweden had more outbreaks of disease in the following years because of the new vaccination laws, Norway's

---

[65] Gregory A. Poland, Robert M. Jacobson, and Inna G. Ovsyannikova, "Trends Affecting the Future of Vaccine Development and Delivery: The Role of Demographics, Regulatory Science, the Anti-Vaccine Movement, and Vaccinomics," *Vaccine* 27, no. 25–26 (May 26, 2009): 3240–44, doi:10.1016/j.vaccine.2009.01.069.

[66] Katie Thomas, "The Race for a Zika Vaccine," *The New York Times*, November 19, 2016, https://www.nytimes.com/2016/11/20/business/testing-the-limits-of-biotech-in-the-race-for-a-zika-vaccine.html.

[67] Robert Roos, "Reports Support Usefulness of School-Based Flu Vaccination," *Center for Infectious Disease Research and Policy*, April 19, 2010, http://www.cidrap.umn.edu/news-perspective/2010/04/reports-support-usefulness-school-based-flu-vaccination.

[68] V. Romanus, R. Jonsell, and S. O. Bergquist, "Pertussis in Sweden after the Cessation of General Immunization in 1979," *The Pediatric Infectious Disease Journal* 6, no. 4 (April 1987): 364–71.

[69] "Pertussis Reported Cases," *WHO World Health Organization: Immunization, Vaccines And Biologicals*, December 1, 2016, http://apps.who.int/immunization_monitoring/globalsummary/timeseries/tsincidencepertussis.html.

coverage of the diphtheria, tetanus, and pertussis (DTP) vaccination increased, and its pertussis incidence declined significantly. By 1993, Norway had a 92% coverage rate for the three-dose schedule and it only saw 17 cases of pertussis; in the same year, Sweden had 11,542 cases.[70,71]

Another more recent example of what can happen when vaccine hesitancy increases and compulsory vaccination laws loosen is the California measles outbreak of 2015. In December 2014, the measles virus spread to forty individuals in Disneyland theme parks. By January 2015, people started showing symptoms and a total of 110 Californians became ill; 45% were unvaccinated, 43% had unknown vaccination status, and the rest had received the vaccination. Twelve of the individuals who contracted the disease were infants, too young to have received the vaccine. Among the others who were unvaccinated, 76% opted out because of personal beliefs. The virus didn't affect California alone; fifteen cases were reported in seven other states.[72] Even though the outbreak was announced to be over in April of 2015, the true results are still pending. Measles is a virus that has the ability to remain latent in the central nervous system, and can reactivate after several symptom-free years. In the worst cases, a patient will contract subacute sclerosing panencephalitis (SSPE), a neurodegenerative disease that is usually fatal.[73]

The state reacted to this public health disaster by instating new strict vaccination regulations for 2016. In June of 2015, California Governor Jerry Brown signed Senate Bill 277, which requires all children to be vaccinated before they enroll in public or private schools,

---

[70] E. J. Gangarosa et al., "Impact of Anti-Vaccine Movements on Pertussis Control: The Untold Story," *The Lancet* 351, no. 9099 (January 31, 1998): 356–61, doi:10.1016/S0140-6736(97)04334-1.
[71] "Pertussis Reported Cases."
[72] Jennifer Zipprich et al., "Measles Outbreak: California, December 2014-February 2015," *Morbidity and Mortality Weekly Report* 64, no. 6 (February 20, 2015): 153–54.
[73] William J. Bellini et al., "Subacute Sclerosing Panencephalitis: More Cases of This Fatal Disease Are Prevented by Measles Immunization than Was Previously Recognized," *The Journal of Infectious Diseases* 192, no. 10 (November 15, 2005): 1686–93, doi:10.1086/497169.

regardless of religious or personal beliefs.[74] This made California the third state in the nation that rejects both personal belief and religious exemptions.[75] However, while important, this law is ineffective because for students who are not moving to different schools, the only checkpoints for immunization are in kindergarten and seventh grade; this means that despite the new legislation, many schools still house unvaccinated children. That is what allowed a measles outbreak to occur in 2017, a year after the policy was instated.[76]

The ongoing measles outbreak in Minnesota provides another example of the dangers of vaccine hesitancy. Similar to California in 2015, Minnesota has very lenient vaccine legislation, allowing for personal belief and religious exemptions. Minnesota is home to a very large Somali-American community, many members of which are anti-vaccine (this sentiment is based on the vaccine-autism link and the recent rise in autism in the Somali community). In fact, the two-year-olds of this community have a vaccination rate of only 42% (as opposed to a rate of 88% in non-Somali children).[77] As of May 1, 2017, thirty-four Minnesotan children under the age of five have contracted measles; almost all of these children are Somali-American and at least thirty-one are unvaccinated.[78] On April 30, 2017, ninety anti-vaccine Minnesotans gathered in Minneapolis to discuss what they viewed to be the real epidemic: autism.[79] It will be interesting to see if the state of Minnesota will follow the example of California in response to this outbreak of disease.

---

[74] Tara Haelle, "California Vaccination Bill SB 277 Signed By Governor, Becomes Law," *Forbes*, accessed February 13, 2017, http://www.forbes.com/sites/tarahaelle/2015/06/30/california-vaccination-bill-sb-277-signed-by-governor-becomes-law/.
[75] "States With Religious and Philosophical Exemptions From School Immunization Requirements."
[76] Karlamangla, "Measles Outbreak Grows in L.A.'s Orthodox Jewish Community despite California's Strict New Vaccination Law."
[77] Matt Sepic, "Public Health Workers Push Back against Anti-Vaccine Claims at Somali Community Meeting," May 1, 2017, https://www.mprnews.org/story/2017/05/01/public-health-workers-push-back-against-anti-vaccine-claims-somali-community-meeting.
[78] "Minnesota (USA) - Measles Update: Outbreak Expands," *DG Alerts: Anesthesiology*, April 28, 2017, http://dgalerts.docguide.com/minnesota-usa-measles-update-outbreak-expands.
[79] Sepic, "Public Health Workers Push Back against Anti-Vaccine Claims at Somali Community Meeting."

Apart from harming those who have contracted measles since the fad began, the false vaccine-autism link is directly hurting the autistic community as well. There are a few reasons for this. First, for many of those living with autism, the fact that parents would refuse vaccinations in order to avoid having autistic children is upsetting, or even dehumanizing. As one woman with autism puts it, "we're facing a massive public health crisis because a disturbing number of people believe that autism is worse than illness or death."[80] In 2015, a mother wrote a poetic article entitled "My Son Has Autism—And I am Not Anti-Vaccine," in which she explains that her son has some difficulties because of his condition, but she would not prefer him to be any other way, and she certainly would not choose to have him unvaccinated instead.[81]

This belief also causes people to spend time and funds on unproductive research looking for the vaccine-autism link. This can take focus away from more promising research that points to genetic or prenatal environmental causes. Studies suggest that aside from genetic factors, which are strongly implicated in the development of autism, exposure during pregnancy to drugs such as thalidomide, certain insecticides, and infection with the rubella virus (which is ironically part of the MMR vaccine) may put the fetus at risk for autism. This can also misguide preventative measures in the long run; instead of working to keep pregnant women safe from certain toxins and viruses, much of the world is directing its energy towards anti-vaccine measures.[82]

It is certainly reasonable for parents to do whatever they must in order to protect their children. However, if they truly want what is best, they must consider the following viewpoint:

---

[80] Sarah Kurchak, "I'm Autistic, And Believe Me, It's A Lot Better Than Measles," *Medium*, February 6, 2015, https://medium.com/the-archipelago/im-autistic-and-believe-me-its-a-lot-better-than-measles-78cb039f4bea.
[81] Carrie Cariello, "My Son Has Autism — and I Am Not Anti-Vaccine," *TODAY.com*, February 5, 2015, http://www.today.com/health/my-son-has-autism-i-am-not-anti-vaccine-t836.
[82] Peter J. Hotez, "How the Anti-Vaxxers Are Winning," *The New York Times*, February 8, 2017, https://www.nytimes.com/2017/02/08/opinion/how-the-anti-vaxxers-are-winning.html.

even if vaccines could cause autism or other harmful side effects in a small number of cases, such a risk would be insignificant compared to the threat of infectious diseases in an unimmunized society. Until the fear of polio and mumps is greater than the fear of autism, the anti-vaccine community will remain unconvinced about the importance of vaccines.

Peter J. Hotez, the director of Texas Children's Hospital Center for Vaccine Development, recently published an article in the *New York Times* entitled "How the Anti-Vaxxers are Winning."[83] In it, he describes the problem of vaccine hesitancy in the United States and explains that infectious disease outbreaks are imminent across the country. One of the greatest problems is that vaccine hesitant parents tend to live in the same areas and send their children to the same schools, thus breaking down the herd immunity in certain communities.[84] Austin Waldorf, a private school in Travis County, Texas, has an exemption rate of over 40%, which is the highest in the state.[85] Because of its concentrated pockets of unimmunized children, Hotez selects Austin, Texas as the next likely site for a measles outbreak.

It is clear that vaccine hesitancy and refusal has the potential for great harm in our society. However, the fears and beliefs of parents making decisions for their children must be taken seriously and addressed with care. Imagine a mother of a child with autism who truly believes that his condition resulted from his routine childhood vaccinations; can a just government rightfully force her to vaccinate her second child? Personal autonomy and informed consent will always be important principles in America, so this issue is especially difficult to address. The chapters to come will explain how policy makers can make ethical and legal

---

[83] Ibid.
[84] Liza Gross, "Parents Who Shun Vaccines Tend To Cluster, Boosting Children's Risk," *NPR*, January 20, 2015, http://www.npr.org/sections/health-shots/2015/01/20/378630798/parents-who-shun-vaccines-tend-to-cluster-boosting-childrens-risk.
[85] Morgan Smith, "Which Texas Schools Have the Highest Rates of Vaccine Exemptions?," *The Texas Tribune*, July 14, 2016, https://www.texastribune.org/2016/07/14/see-studnet-vaccine-exemptions-school/.

decisions regarding vaccination legislation within vaccine hesitant societies, and what such policy might look like.

Chapter 3

The Ethics of Compulsory Vaccination

The implementation of a government-mandated vaccination program raises several important ethical issues. On the governmental level, ethical considerations revolve around the balance between public welfare and individual autonomy. On the level of the individual, one must review the moral responsibilities of parents to their children and citizens to their neighbors. The interplay of these varying factors complicates the creation of an ethical framework for compulsory vaccination. However, after a thorough evaluation of the benefits and costs on both governmental and individual levels, it is clear that such programs can meet ethical standards and ought to be implemented. Many countries, including the United States, have such programs today in order to keep immunization levels high (the specifics of the American program will be discussed more fully in the chapters to follow). This chapter will outline a list of criteria that a governmental vaccination program must meet in order to be considered ethically sound, and will discuss several ethical ramifications of compulsory vaccinations and vaccine hesitancy in American society.

Part I: Governmental Ethics and the Five Criteria

The primary job of a democratic government is to protect its citizens from harm. However, "harm" comes in many forms, and the best way to provide protection is not always clear. Sometimes, the most efficient means of protection from one danger can inadvertently create a different kind of danger. In the United States today, governmental responses to infectious diseases and vaccinations can fall victim to this problem. The maintenance of public

health is an important concern for policy makers because it protects the general welfare of a population. However, when the enacted health policies take rights away from individuals, the government may not be doing its best to protect the freedom of its citizens. When the government gives too much individual freedom, however, it risks endangering the entire population as well as smaller groups who cannot choose for themselves, such as children.

Before enacting policy, the United States government must decide which protections and freedoms are most important. Many laws are established based upon the sanctity of individual rights and liberties. The Bill of Rights includes several examples of such laws, which are put into place to protect personal freedoms. On the other hand, when a government introduces a mandatory military draft, it decides that the wellbeing of the country and its population is more important than the rights of individuals to choose; in other words, it sacrifices the ideal of personal liberty in order to achieve a greater goal. Oftentimes, an infectious disease outbreak is treated like fighting a war. Therefore, although not all health policy decisions are made with this theory in mind, we will assume that the goal of a vaccine program is to create the most good for the greatest number of people. This "greatest good" principle is the philosophy of Jeremy Bentham, who is considered the founder of modern utilitarianism.[1]

From a utilitarian point of view, the ethical necessity of a mandatory immunization program is obvious. This philosophy aims to maximize wellbeing (i.e., achieve the greatest good for greatest number of people) when coming to conclusions; as long as the benefits of an action outweigh the costs, the action can be considered ethical.[2] As identified in preceding chapters, the benefits of vaccines are numerous: prevention and eradication of deadly infectious diseases, development of herd immunity in a population, and decreased societal and personal healthcare

[1] Jeremy Bentham, *The Collected Works of Jeremy Bentham: An Introduction to the Principles of Morals and Legislation* (Clarendon Press, 1996).
[2] John Stuart Mill, *Utilitarianism* (Longmans, Green and Company, 1901).

costs. It is also important to note that these benefits are large in scale, which increases their utilitarian value. In addition to protecting individual people from illness, immunizations benefit entire populations. For example, the benefits of the smallpox vaccination program, which eradicated the disease worldwide, are so tremendous that they will increase the wellbeing of every person for the rest of time. Comparatively, the costs of the smallpox inoculation, which was sometimes deadly, now seem insignificant.

In retrospect, the maximization of utility from the smallpox vaccine is clear. However, the costs of mandatory vaccination programs today must be considered and weighed against the benefits in order to truly determine their ethical value and to decide how they can be most ethically implemented. The major costs of such programs include the health and safety risks that vaccines pose, as well as the scrutiny and frustration of the vaccine hesitant community. Overall, the benefits of vaccines must diminish these costs in order for a program to be deemed ethical.

A vaccine program seeks to maximize general health and welfare. Therefore, a cost-benefit analysis can help determine the ethics of mandatory immunizations and the best way to implement a program that protects citizens without creating a significant number of dangers or negative outcomes. Although it is impossible to attach value to certain actions and outcomes, we may speculate that, for example, a measles vaccination program provides significant benefit, given that 3 to 4 million people were infected annually in the United States before the vaccine became available.[3] We may also assume that significant cost is accrued from an unsafe vaccine, or from the unhappiness of thousands of American parents who feel they are being forced to put their children at risk. (It is important to note that this philosophical examination is part of a thought experiment specific to this thesis—although they weigh costs and benefits, policy

[3] "Measles History," *Centers for Disease Control and Prevention*, November 3, 2014, https://www.cdc.gov/measles/about/history.html.

makers in the United States do not write public policy based exclusively on utilitarian philosophy.)

One way to outline an ethical framework for vaccination programs is to develop a list of criteria for the vaccines included in the program. The Netherlands created such a list for their national vaccination program in 2007,[4] and other similar discussions exist in the bioethics literature.[5] Drawing from these discussions and using a cost-benefit analysis based on the philosophical principle described above, we can create a list of criteria that an immunization program must meet before it can be ethically mandated:

1. The vaccines must be as safe and effective as possible before administration is mandated.
2. The risks posed by vaccines must be no greater than any other activity practiced in a person's everyday life. Additionally, if a vaccine does cause a debilitating side effect, the government must provide compensation.
3. The vaccines included in the program must target a clear public health threat.
4. The vaccines must be affordable and accessible.
5. Assuming the lack of an immediate threat, patients must consent to the administration of the vaccines.

[4] Marcel F. Verweij and Hans Houweling, "What Is the Responsibility of National Government with Respect to Vaccination?," *Vaccine* 32, no. 52 (December 12, 2014): 7163–66, doi:10.1016/j.vaccine.2014.10.008.
[5] Marcel Verweij and Angus Dawson, "Ethical Principles for Collective Immunisation Programmes," *Vaccine* 22, no. 23–24 (August 13, 2004): 3122–26, doi:10.1016/j.vaccine.2004.01.062.

1. Vaccine safety and efficacy:

In order for the government to administer vaccines as part of a successful public health effort, the vaccines must not become a source of health problems. The fact that immunization is a preventative measure makes this point even more important; if a population that starts out healthy undergoes a prophylactic treatment that *causes* illness or injury in a significant number of patients, the point of the treatment is moot. If the prophylactic treatment does not effectively prevent illness, it gives false hope and does not achieve public health goals. Both of these problems would significantly decrease the benefits of a mandatory program and would cause such a program to be unethical.

For this reason, the government cannot in good conscience mandate the administration of a vaccine that is unsafe or ineffective, and steps must be taken to ensure its reliability before enforcing its use. Luckily, drug approval in the United States is a stringent process, and pharmaceutical companies spend years perfecting vaccines before submitting them for FDA approval and putting them on the market. Typically, pre-marketing clinical trials are done in three thorough phases, all of which are monitored. If a vaccine passes this stage, it may move forward with the approval process, which includes presentation of efficacy and safety information and the release of all production information for examination. Even after a vaccine is approved, the FDA continues to oversee its manufacture.[6]

The goal of this process is to ensure that vaccines do not put populations at risk and that they effectively prevent infectious diseases. If a vaccine later proves to be unsafe or ineffective, the government and pharmaceutical companies take the necessary steps to restore these features.

[6] Center for Biologics Evaluation and Research, "Biologics License Applications (BLA) Process (Biologics) - Vaccine Product Approval Process," WebContent, *U.S. Food and Drug Administration*, accessed March 7, 2017, https://www.fda.gov/BiologicsBloodVaccines/DevelopmentApprovalProcess/BiologicsLicenseApplicationsBLAProcess/ucm133096.htm.

For example, drug manufacturers and researchers update the influenza vaccine annually in order to maintain efficacy as new strains of the virus develop. In addition, maintenance of vaccine safety is always a primary concern in the United States. The best examples of the government taking action in order to guarantee vaccine safety are the pertussis and polio vaccines.

The pertussis vaccine has two forms. The whole-cell pertussis vaccine, developed in the 1950's, is very effective, but has been associated with redness at the site of injection, fevers, and even neurological harm, as some scientific communities suggest.[7,8] In response to these safety concerns, Japan developed a new, acellular form of the vaccine in 1981. Although it is a little less effective,[9] it still prevents disease on a community-wide scale and has proven to have fewer side effects. In 1992, the United States started using the acellular vaccine alongside the whole-cell vaccine, and by 2001, stopped using the whole-cell pertussis vaccine altogether.[10]

As described in chapter one, there are also two different polio vaccines available on the market: the inactivated polio vaccine (Salk) and the oral polio vaccine (Sabin). Both vaccines are highly effective, but the Sabin vaccine, which is live-attenuated, can revert to the malignant form and cause paralysis in very rare cases. Because it is easier to store and administer, the Sabin vaccine is still used in many areas around the world, especially in developing countries. However, the United States now uses the Salk vaccine exclusively because it poses very minimal risks.[11]

---

[7] "WHO | Pertussis," *World Health Organization*, accessed March 8, 2017, http://www.who.int/biologicals/vaccines/pertussis/en/.
[8] David A Geier and Mark R Geier, "An Evaluation of Serious Neurological Disorders Following Immunization: A Comparison of Whole-Cell Pertussis and Acellular Pertussis Vaccines," *Brain and Development* 26, no. 5 (August 2004): 296–300, doi:10.1016/S0387-7604(03)00169-4.
[9] Silke David, Ralph van Furth, and Frits R Mooi, "Efficacies of Whole Cell and Acellular Pertussis Vaccines against Bordetella Parapertussis in a Mouse Model," *Vaccine* 22, no. 15–16 (May 7, 2004): 1892–98, doi:10.1016/j.vaccine.2003.11.005.
[10] Geier and Geier, "An Evaluation of Serious Neurological Disorders Following Immunization."
[11] Shahzad, "Time for a Worldwide Shift from Oral Polio Vaccine to Inactivated Polio Vaccine."

It is important to note that, while vaccine safety is always a concern, its significance is relative. In 1952, there were 57,879 cases of polio and 3,145 polio-associated deaths in the United States.[12] The high costs associated with such an outbreak are significant, and include the actual cases of illness as well as family suffering, financial burden, and terror throughout the population. Even though the virus harmed a small percentage of the entire country, the constant fear of polio infection reduced the quality of life for everyone. Therefore, the relative risks of the Sabin vaccine, which caused one case of vaccine-derived poliovirus per 1.4 million doses when it was first administered in the United States,[13] were so minute in comparison to the risks of the actual disease that they were insignificant. However, now that polio no longer exists in the United States, causing a few cases of disease through the use of a vaccine is much more serious. Standards are constantly shifting based on the state of public health, which is why vaccine safety must constantly be monitored and the use of a cost-benefit analysis is so important.

It is clear that the United States takes a great amount of precaution when it comes to vaccine safety and efficacy and closely abides by the first of the criteria for an ethical vaccination program. Avoiding unsafe and ineffective vaccines allows the country to increase the overall benefit of a vaccine program. Therefore, the government does not mandate the use of any vaccines that it deems unsafe, and it also aims to increase safety and efficacy, as well as to avoid risks whenever possible.

---

[12] "Reported Cases and Deaths from Vaccine Preventable Diseases, United States, 1950-2013," in *Epidemiology and Prevention of Vaccine-Preventable Diseases*, 13th ed. (Centers for Disease Control and Prevention, 2015).

[13] "Information Sheet: Observed Rate of Vaccine Reactions, Polio Vaccines" (World Health Organization, May 2014).

2. No more than minimal risk:

Having an institutionalized vaccination program comes with certain inevitable risks. No matter how hard scientists work to ensure the safety of vaccines and no matter how safe the vaccines are, there will always be the potential for side effects, mild or severe. In order to review this problem, we may look at precedents that have been set in other similar situations (i.e., situations that produce positive outcomes but may pose small risks). One example is human subjects research. In order to perform research that involves human subjects, a researcher must gain the approval of the IRB, or Institutional Review Board. One of the criteria for qualifying as an "exempt" or "expedited" study (the lower two levels of study types, which do not have to undergo a full board review) is that the study presents "no more than minimal risk to subjects."[14] This means that the participants will not be exposed to anything that might put them at a higher risk than regular everyday activities. Since this is a principle of the IRB, whose primary purpose it is to protect people from harm, we may apply a similar metric to the administration of vaccines.

While the act of vaccination is routine, it still qualifies as a medical procedure. Therefore, we will first compare it to other standard medical procedures or drugs in order to ensure that it does not pose a greater risk. It is important to remember that all medical procedures have risks. The administration of antibiotics in order to cure disease can be dangerous, and can even cause death, but very few individuals would refuse antibiotics or other life-saving treatment if their health were threatened. Individuals willingly expose themselves and their children to small amounts of X-ray radiation in order to diagnose broken bones, despite the potential carcinogenic

[14] "IRB Policies and Procedures Manual" (The University of Texas at Austin Office of Research Support and Compliance), accessed March 14, 2017, https://research.utexas.edu/ors/human-subjects/policies-and-procedures/.

side effects. Surgery and general anesthesia are far more dangerous than a vaccine, but the country is not facing an anti-appendectomy threat.

Perhaps the difference between vaccines and other medical procedures is that vaccines are proactive and many other risky procedures are reactive; the benefits of reactive procedures seem to more obviously outweigh their risks. However, there are several examples of prophylactic treatments or tests that Americans regularly undergo in order to remain healthy in the future, despite the side effects. Semiannual dental X-rays and annual mammograms release radiation that can cause cancer over a long period of time.[15] It is recommended that all adults over the age of fifty undergo screening colonoscopies, which pose the risk of perforation and even death.[16] In addition, millions of women in the United States use birth control in order to proactively avoid pregnancy. From 2006-2010, 88% of reproductive-aged American women were using an invasive birth control method such as the pill, the patch, injectable hormone therapy, or an intrauterine device[17] despite a range of negative side effects, including mood swings, heart disease, high blood pressure, and blood clots.[18] Clearly, these risks do not deter most of the population. In fact, when women feared that their access to birth control would be threatened after Donald Trump's election, requests for intrauterine devices rose 19%.[19]

---

[15] Amy Berrington de González and Sarah Darby, "Risk of Cancer from Diagnostic X-Rays: Estimates for the UK and 14 Other Countries," *The Lancet* 363, no. 9406 (January 31, 2004): 345–51, doi:10.1016/S0140-6736(04)15433-0.
[16] T. H. Lüning et al., "Colonoscopic Perforations: A Review of 30,366 Patients," *Surgical Endoscopy* 21, no. 6 (June 1, 2007): 994–97, doi:10.1007/s00464-007-9251-7.
[17] Kimberly Daniels, William D. Mosher, and Jo Jones, "Contraceptive Methods Women Have Ever Used: United States, 1982–2010," *National Health Statistics Reports, U.S. Department of Health and Human Services* 62 (February 14, 2013).
[18] "Contraception and Birth Control," *NIH Eunice Kennedy Shriver National Institute of Child Health and Human Development*, accessed March 14, 2017, https://www.nichd.nih.gov/health/topics/contraception/conditioninfo/Pages/faqs.aspx.
[19] Alexandra Sifferlin, "More Women Want IUDs after President Trump's Election," *Time*, January 26, 2017, http://time.com/4650190/iud-trump-election/.

Many can see that the risks of these proactive treatments are insignificant compared to the conditions that they are trying to prevent; some X-ray radiation exposure once a year is better than undetected breast cancer, and the high blood pressure and mood swings caused by birth control pale in comparison to the side effects of an actual pregnancy. Vaccines should be seen in the same light. Their potential risks are no worse than any of these other medical procedures (in fact, they are less severe), and they certainly do not compare to the effects of an infectious disease outbreak.

Thus, vaccines pose no more than minimal risk within the category of medical procedures. We may now increase our standard and compare them to simple, everyday activities. Individuals constantly put themselves in danger for the sake of utility and normalcy in many non-healthcare related circumstances, i.e., during these "everyday activities." Swimming comes with the risk of drowning; playing sports comes with the risk of injury; buying a house comes with the risk of mortgage debt. Driving a car, riding a bike, or using any other form of transportation is statistically riskier than receiving childhood vaccines. In 2015, 38,300 people died and 4.4 million people were seriously injured in motor vehicle accidents in the United States.[20] These numbers are too great to even compare to vaccine-related injury; in fact, they are more akin to infectious disease counts in the pre-vaccine era. As one pediatrician explains to parents, "the most dangerous part of vaccinating your child is the drive to the office."[21] Still, people voluntarily take the risk of driving on a daily basis in order to make their lives more comfortable.

---

[20] Bill Chappell, "2015 Traffic Fatalities Rose By Largest Percent In 50 Years, Safety Group Says," *The Two-Way: Breaking News from NPR*, February 18, 2016, http://www.npr.org/sections/thetwo-way/2016/02/18/467230965/2015-traffic-fatalities-rose-by-largest-percent-in-50-years-safety-group-says.
[21] Chad Hayes, "My Kids Are Vaccinated Because I Love Them," *KevinMD.com*, April 19, 2017, http://www.kevinmd.com/blog/2017/04/kids-vaccinated-love.html.

Clearly, individuals regularly choose to jeopardize their wellbeing for pleasure or the maintenance of normalcy, or to prevent an outcome that is potentially worse (e.g., walking ten miles to work and arriving late). Of course, exceptions exist. When the risks clearly outweigh the benefits, attitudes about these activities can change. A person will decide not to drive during a snowstorm or run with a sprained ankle unless it is absolutely necessary. Vaccines are similar to these everyday activities: even if vaccinations harm a very small percentage of patients, their benefits are so great that the procedure is worth the risk for those who are not immunocompromised or otherwise medically contraindicated from receiving immunizations. Just like driving, vaccinations increase the comfort and ease of everyday life to such a great extent that it would be counterintuitive to refuse vaccines because of the potential side effects alone; their risks are no greater than any of these other activities. Therefore, it is not the risks of the immunization procedure itself that matter most for a government deciding whether to mandate vaccination.

However, when it is clear that a mandatory vaccine has caused injury, it is the government's responsibility to make up for this error. If the United States government requires a person to undergo a procedure, and that procedure causes significant injury, the government has broken the "no more than minimal risk" principle. Governmental compensation can be in the form of free healthcare or monetary compensation for the injury itself. The United States has such a program in place. The National Vaccine Injury Compensation Program allows an individual to file a claim after suffering from a serious vaccination side effect and, if approved, the government will provide financial compensation (see footnote for the program's statistics).[22]

[22] "National Vaccine Injury Compensation Program," *US Department of Health and Human Services: Health Resources and Services Administration*, February 2017, https://www.hrsa.gov/vaccinecompensation/. Since 1988, almost 18,000 petitions have been filed; of

This offsets the cost of such an incident for a family. Even though vaccines are as safe as possible and are no riskier than driving a car, this provides insurance to uncertain parents and is an important part of any ethical vaccine program.

3. Clear public health threat:

In order for a vaccine to have a cost-benefit ratio favorable enough for it to be ethically mandated, it must protect against an infectious disease that is harmful, highly communicable, and present. This means that the pathogen has the potential to infect and hurt many people, and that it would exist in the society if the vaccine were not in use. Sometimes, it is the sheer number of potential cases that causes the significant public health threat (i.e., a high R_0 number). For example, although chickenpox does not seem like a very threatening illness, the varicella vaccine prevents 3.5 million cases of chickenpox and 9 thousand hospitalizations per year in the United States.[23] Other times, the severity of the disease is most important. Polio, for example, did not cause as many cases of disease per year, but it had the potential to be debilitating. Thus, for infectious diseases like these, it makes ethical sense to require immunization.

The question that must be answered is which diseases have vaccinations but do not qualify. First, there are those that are not severe enough for mandatory immunization to be warranted, both ethically and monetarily. Influenza is common, but most individuals recover without too much distress (immunization for the flu also needs to be boosted annually, which makes a mandate less feasible). However, when there is a flu strain that threatens to cause severe illness or even death on a larger scale, it becomes more ethical to require vaccination. For

---

those, 5,269 were deemed compensable. Overall, the United States has spent $3.6 billion in compensation.

[23] "Monitoring the Impact of the Varicella Vaccination," *Centers for Disease Control and Prevention*, July 1, 2016, https://www.cdc.gov/chickenpox/surveillance/monitoring-varicella.html.

example, the H1N1 pandemic of 2009 caused an estimated 60.8 million cases of disease and 12,469 deaths in the United States. With a risk of death 8 to 12 times greater than normal seasonal flu, this particular strain would have fit well into a national immunization program.[24]

There are also infectious diseases that are dangerous but do not have a strong presence in the United States, and therefore cannot be ethically required by law. Yellow fever, tuberculosis, dengue, and cholera are some examples of such infectious diseases. However, a person can be ethically required to vaccinate if he is traveling to a country where these diseases are risks, particularly because it would be easy for a traveler to bring back an infectious disease from abroad. According to the World Health Organization, the yellow fever vaccine is strongly recommended (although not required) for individuals traveling to many countries in Africa and South America, where the disease is endemic. In addition, there is a list of countries that require proof of vaccination for travelers arriving from areas where yellow fever is a risk; the United States is not on this list.[25]

Diseases that are more specific to or dangerous for a particular population may also not require a vaccine mandate. Imagine that there is a vaccine for HIV. While it causes a terrible disease, this virus does not spread like mumps or polio; the only people who come into contact with it are those who engage in sexual activity or share needles with other infected individuals. Most will never be exposed to it. If we use the same thought experiment with a Zika vaccine, it is likely that it would be recommended for women and their partners only if they are a) living in or

[24] Sundar S. Shrestha et al., "Estimating the Burden of 2009 Pandemic Influenza A (H1N1) in the United States (April 2009-April 2010)," *Clinical Infectious Diseases: An Official Publication of the Infectious Diseases Society of America* 52 Suppl 1 (January 1, 2011): 1, doi:10.1093/cid/ciq012.
[25] "Country List: Yellow Fever Vaccination Requirements and Recommendations; Malaria Situation; and Other Vaccination Requirements" (World Health Organization), accessed March 19, 2017, http://www.who.int/ith/ITH_country_list.pdf.

traveling to risky areas and b) pregnant or trying to become pregnant. Such vaccines would not have a place in a national vaccination program.

The mode of transmission is also an important factor. Like HIV, there are certain infectious diseases for which spread is dependent on practice. A person cannot help if he comes into contact with a diphtheria patient or food that is contaminated with hepatitis A. However, he can monitor his own sexual practices. This is what makes the Gardasil vaccine so tricky. HPV is ubiquitous in the American population, and the vaccine can protect against several forms of HPV-caused cancers. However, a person can only contract HPV by engaging in sexual activity with an infected partner, and an infected person can only spread HPV through sex. It is certain that two uninfected, monogamous partners will avoid the virus completely. So should the vaccine be optional?

One of the greatest dilemmas posed by this vaccine is that it is administered to middle school children, but their parents make the decision for them. Many parents are unaware of their children's sexual practices and may refuse the vaccine based on the assumption that their children will remain abstinent until an older age. This puts such adolescents at risk for contraction of HPV. It also does not account for the possibility of rape. Thus, an argument can be made for the mandate of Gardasil. The most ethical choice in such a circumstance is to educate children about the vaccine and to allow them to choose for themselves. If a child feels confident that she will not engage in sexual activity until a later time, it is fair to allow her to delay the vaccine. On the other hand, if a child plans on having sexual relations sooner, she should be able to receive the vaccine, despite what her parents believe. However, because of parental authority laws, this is a scenario where government policy cannot align perfectly with the most ethical choice.

There are many factors about diseases themselves that the government must consider before deciding which ones should carry mandatory vaccination laws. If a disease is not present in an area, it does not make sense to vaccinate the inhabitants against it. The same applies for diseases that are specific to one group, mild, and/or not highly communicable. For the most part, the United States does not mandate vaccines for infectious diseases that meet these criteria (one possible exception is hepatitis B, which poses a dilemma similar to HPV). As more vaccines are released for diseases like Ebola and Zika, it will be important for the United States government to consider if the threats of certain pathogens are great enough to mandate their vaccines on a large scale. For example, serogroup B meningococcal is a deadly pathogen that causes meningitis in adolescents. It claimed the lives of college students on campuses around the country in recent years. Therefore, when the vaccine became available in the United States in 2014, it was added to the vaccination schedule.[26]

4. Affordable and accessible:

The United States government cannot ethically require every citizen to undergo a procedure that is inaccessible to some. Some parents cannot pay for the vaccines or do not live close enough to a pediatrician to maintain the vaccine schedule. In addition, parents living below the poverty line may work multiple jobs, preventing them from taking their children to the doctor during business hours. In such cases, it is the government's duty to ensure that the child is vaccinated. There are a couple reasons for this. If there are enough parents who want to vaccinate their children but struggle to do so, herd immunity may not be reached, especially in communities that are poor or rural. This would break down the immunization program entirely in

[26] Angelika Banzhoff, "Multicomponent Meningococcal B Vaccination (4CMenB) of Adolescents and College Students in the United States," *Therapeutic Advances in Vaccines* 5, no. 1 (February 1, 2017): 3–14, doi:10.1177/2051013616681365.

multiple areas around the country. In addition, from a moral standpoint, it would be unfair to penalize individuals for something that is out of their control.

Therefore, along with any government immunization program there must be a guarantee that parents will not struggle to meet the requirements. In the United States, there is a disparity in the vaccine rate between children living below the poverty line and children living above it. In addition, children living in rural areas have lower coverage for certain vaccines.[27] The American government is working to amend this. For example, the Vaccines for Children program provides federally funded vaccinations to children who would otherwise be unable to pay.[28] However, much more must be done in the United States today in order to ensure the herd immunity in these communities. Keeping vaccination clinics open late and on weekends, vaccinating children at school or daycare, and setting up temporary pop-up clinics in rural areas are some ways that the government can reach these communities.

5. Informed consent:

Informed consent is a very important principle in the United States healthcare system. However, it is relatively new. Many of the patient protection laws we have today were developed out of recent tragedies. The Nuremberg Code was created after the trials of several Nazi scientists, who had performed blatantly unethical experiments on their prisoners without consent. As the first guide of its kind in the modern Western world, the Nuremberg Code outlines the

[27] Holly A. Hill et al., "Vaccination Coverage Among Children Aged 19–35 Months — United States, 2015," *MMWR. Morbidity and Mortality Weekly Report* 65 (2016), doi:10.15585/mmwr.mm6539a4.
[28] "Vaccines for Children Program," *Centers for Disease Control and Prevention*, February 18, 2016, https://www.cdc.gov/vaccines/programs/vfc/index.html.

criteria that a human research experiment must meet in order to qualify as ethical; the first is that the subject must voluntarily consent.[29]

The Tuskegee Syphilis Study produced a similar community response. From 1932 to 1972, scientists from the U.S. Public Health Service studied the full course of the syphilis disease in a group of black men, who thought they were being treated for "bad blood." The subjects did not consent to involvement in such a study and were not given treatment when penicillin became a proven remedy for syphilis.[30] Inspired in part by this disregard for human ethics, the Belmont Report was written in 1978. This includes three major principles for human subjects research: respect for persons, beneficence, and justice. The guidelines of the Belmont Report are used in clinical practice as well as research to ensure that all patients are treated ethically.[31]

Thus, informed consent and patient autonomy cannot simply be neglected in an ethical vaccination program, even if it makes achieving high rates of vaccination more difficult. Considering the history from which they were developed, abandoning America's core bioethics principles would come at a significant moral cost. There are exceptions to this rule when the costs of a public health crisis would significantly overshadow the benefits of patient autonomy. For example, if a rare vaccine-preventable disease entered the United States and had the potential to take millions of lives, the importance of informed consent would decrease significantly (although it would be unlikely for anyone to refuse such a vaccine, so the problem might never

---

[29] "Nuremberg Code," *United States Holocaust Memorial Museum*, accessed March 23, 2017, https://www.ushmm.org/information/exhibitions/online-exhibitions/special-focus/doctors-trial/nuremberg-code.
[30] "U.S. Public Health Service Syphilis Study at Tuskegee," *Centers for Disease Control and Prevention*, December 22, 2015, https://www.cdc.gov/tuskegee/timeline.htm.
[31] Eric J. Cassell, "The Principles of the Belmont Report Revisited: How Have Respect for Persons, Beneficence, and Justice Been Applied to Clinical Medicine?," *Hastings Center Report* 30, no. 4 (July 8, 2000): 12–21, doi:10.2307/3527640.

arise). Assuming the lack of a public health emergency, however, parents must give informed consent before medical professionals can administer shots to their infants.

There are several issues that go along with this. First, in order for the informed consent to qualify, the patients must actually be informed. This becomes more difficult because of the availability and popularity of false information about vaccinations. If a parent believes that her child will develop autism after receiving the MMR vaccine, her refusal to vaccinate is not informed. This is why education is so important. Physicians must be given ample time to teach their patients about vaccinations so that patients can decide to vaccinate based on their own understanding rather than feeling coerced.

However, such an expectation may inhibit a national vaccination program from working in an imperfect world. In order to reach herd immunity, it is acceptable to motivate parents to consent. This means that the laws in place today, which make school enrollment dependent on vaccination status, is ethical. Vaccination still requires informed consent, and there are ways for parents to refuse (i.e., if they wish to homeschool their children). This means that patient autonomy remains intact, but the choice is shifted slightly to include a healthcare decision as well as an educational decision. In such a system, immunization coverage remains high, the nation remains safe, and parents still have the ability to choose.

If all five of the above criteria are met in an immunization program, then it can be considered ethically sound, with sufficient benefits to outweigh costs such as negative feelings from parents and rare vaccine-caused injury. The most important aspect of such a program is that it keeps a population healthy and free from threat. However, the government itself must not

become a threat through unethical mandates. This is why a systematic approach to vaccine ethics is so important.

Part II: Individual Ethics

Even though vaccinations appear to be personal choices, they have community-wide effects. This is why they bring up so many difficult ethical concerns. We have concluded that it is ethical for the government to protect its community through a vaccination program, as long as certain precautions are taken. We must now discuss this issue through a different lens: what is the ethical responsibility of an individual to his community with respect to vaccinations?

When a child is vaccinated, he is protecting every person he comes into contact with; when he is not, he is endangering countless others. In our society, people are expected to take precautions for the sake of the safety and comfort of those around them. Laws are put into place in order to ensure that one person cannot harm another. The illegality of murder and assault is an obvious example. However there are several others that affect all people during everyday activities. Drivers abide by laws that are inconvenient but are meant to keep others safe (e.g., driving sober and at the speed limit, stopping at red lights, staying within a lane, etc.). A person may not yell "fire!" in a theatre. A noise ordinance is an example of a low-stakes protective law that takes away freedom from one neighbor in order to make another more comfortable. Perhaps we can look at vaccination as a common courtesy, similar to keeping quiet after 10:30 p.m. or staying silent in a movie.

However, it is clear that vaccines go beyond these other courtesies because they affect community health on a large scale. Imagine that a group of unvaccinated children enters a theme park and causes a measles outbreak. Among the cases are infants who had not yet received their

vaccines, children with cancer who could not be vaccinated, and many others for whom the immunization process failed. When a parent decides not to vaccinate his child and then exposes the child to the world, he is making an unethical, potentially fatal choice.

Some may make the argument that as long as the child is not sick, he is not a threat. However, because the incubation periods for many of these diseases are long, and the presentations from case to case are different, it is impossible to know whether a child is actively spreading a pathogen. So, it may be fair to treat unvaccinated children as if they are always potentially infected. When a child is sick with a contagious disease, his parents are expected to keep him home from school (a high-stakes courtesy to the other parents and children). In fact, it is an unethical decision to send a contagious child into close quarters with other healthy children. Why should a parent be allowed to send a child to school if he is unvaccinated?[32]

The ethics of vaccinations go beyond community protection, however. More importantly, a parent has a duty to protect her child. When a parent chooses not to vaccinate her children, she is putting them at risk for a multitude of infectious diseases and health problems in the future. It is selfish for a parent to allow her political or ideological beliefs about vaccinations interfere with her doctor's recommendations for the health of her baby. Similar to driving a child without a car seat or refusing to baby-proof a dangerous house, choosing not to immunize a baby is neglectful at best. If a mother refuses the MMR vaccine and her child then dies from measles-related complications, what are the ethical ramifications of her actions?

Ethically speaking, a person must do his part to maintain the health and wellbeing of his community and his family. It is simply unethical for a parent to withhold important preventative treatment from his children. The immorality of such a choice is only amplified when it is

[32] In the context of this section, "unvaccinated" refers to those who are willingly refusing vaccination, not those for whom it is medically contraindicated.

considered on a community-wide scale, where others' lives are also put at risk. However, whether or not to act ethically is a personal decision. The only way to influence individual ethics is through legal action. Vaccination policy and the methods by which the government can control decision-making in order to keep the public healthy will be discussed in the next chapter.

Chapter 4

The Legal Framework for Compulsory Vaccination

It is clear that it is the government's ethical duty to ensure that the population of the United States is immunized. In order to successfully vaccinate an entire community, the government must transition these hypothetical ethical ideals into policy. This process can be difficult because such policy often disregards the personal autonomy of citizens. However, it is important to note that this is not an issue specific to vaccination programs; many other compulsory laws exist in the United States. For example, all children must attend school, regardless of their own desires. Most states require that all passengers in a vehicle wear seat belts. In fact, in 34 states, a driver can be pulled over and ticketed if a passenger is not wearing a seatbelt.[1] Men must register for the draft and drivers must own car insurance. These are just a few examples of how the United States legal system mandates certain behavior.

Vaccine legislation has historically been contested, and it is the court decisions resulting from these debates that set precedent for vaccine laws today. Some of the earliest cases of this kind involved the smallpox vaccination. In 1894, the Pennsylvania Supreme Court ruled that the state could refuse entry of unvaccinated students to school during smallpox epidemics.[2] Utah, Minnesota, and New York made similar rulings in 1900, 1902, and 1903, respectively.[3] The issue of compulsory vaccination reached the Supreme Court of the United States in 1905, with *Jacobson v. Massachusetts.* At this time, eleven states had vaccine mandates for smallpox during

[1] "Seat Belts," *Governors Highway Safety Association: The States' Voice on Highway Safety*, 2016, http://www.ghsa.org/state-laws/issues/Seat-Belts.
[2] Mary Holland, "Compulsory Vaccination, the Constitution, and the Hepatitis B Mandate for Infants and Young Children," *Yale Journal of Health Policy, Law, and Ethics* 12, no. 1 (March 3, 2013), http://digitalcommons.law.yale.edu/yjhple/vol12/iss1/2.
[3] Ibid.

periods of outbreak. This Supreme Court case upheld Massachusetts's smallpox vaccine mandate, which charged adults a five-dollar fine for noncompliance. Jacobson argued that this law violated his right to life, liberty, and property, and that his right to his own body outweighed the government's public health concerns. However, the Supreme Court decided that personal liberties are limited, especially when public safety is at risk.[4] They cited the federal government's right to impose a draft as a similar constitutional measure. However, they stressed that compulsory vaccinations were necessary only in emergency situations, and that medical exemptions were important and should never be withdrawn (this became the basis of religious and ideological exemptions as well).[5]

At first, *Jacobson* was used to justify vaccine mandates during active epidemics. By 1916, however, its implications broadened to include preventative measures of public health safety, with cases supporting prophylactic vaccine laws in Alabama[6] and Kentucky.[7] In 1922, *Zucht v. King* cited *Jacobson* in its decision to uphold a school's right to deny access to students who were not vaccinated; this extended *Jacobson* to include preventative vaccination measures to children as well as adults.[8] By the mid-twentieth century, during the first years of the polio vaccine, the interpretation of *Jacobson* had broadened enough to support most school vaccination mandates on preventative grounds alone.[9]

---

[4] Harlan John, Jacobson v. Massacusetts, 197 U.S. 11 (United States Supreme Court February 20, 1905).
[5] Holland, "Compulsory Vaccination, the Constitution, and the Hepatitis B Mandate for Infants and Young Children."
[6] John T. Fitzpatrick, *Judicial Decisions on Public Law* (The American Political Science Review, 1917), http://archive.org/details/jstor-1943993.
[7] Holland, "Compulsory Vaccination, the Constitution, and the Hepatitis B Mandate for Infants and Young Children."
[8] Brandeis Louis, Zucht v. King 260 U.S. 174 (United States Supreme Court November 12, 1922).
[9] Holland, "Compulsory Vaccination, the Constitution, and the Hepatitis B Mandate for Infants and Young Children."

Public health and safety is not the only problem regarding autonomy in childhood vaccination. Another important consideration is the safety of the child. Because most vaccines are administered to children who are too young to voice their own opinions, the decision of whether to vaccinate is given to their parents. Any religious or personal belief exemption is submitted by the parent, even though the child is the subject. This means that a child, who may not agree with anti-vaccine sentiments as an adult, might be subjected to a dangerous infectious disease because of his parents' choice. In such a case, would the parents be guilty of neglect? Ethically, the parent is in the wrong, but legally such a decision is more difficult to make.

United States law firmly supports the right of the parent to make his or her own decisions when raising a child. However, it requires that parents give their children at least a minimal amount of care. Included in this minimum is refraining from abuse, sending them to school, and vaccinating them against smallpox.[10] In 1966, the Arkansas court ruled in *Mannis v. State* that keeping a student unvaccinated and therefore out of school classified as neglect.[11] This case directly applies to the neglect of a parent keeping a child out of school, not the neglect of a parent refusing to vaccinate a child.

However, a strong argument can be made for the neglectful nature of anti-vaccine parents. By refusing to vaccinate their children based on their own personal beliefs, they are putting their children at direct risk of dying from an infectious disease. Courts have recognized comparable cases of Jehovah's Witnesses refusing blood transfusions for their young children. The New Jersey case *State v. Perricone* decided that it is neglectful for parents to refuse life-saving blood transfusions for their children on religious grounds,[12] citing the *Prince v.*

[10] Joseph Goldstein, "Medical Care for the Child at Risk: On State Supervention of Parental Autonomy," *The Yale Law Journal* 86, no. 4 (1977): 645–70, doi:10.2307/795639.
[11] Holt, Mannis v. State 398 S.W.2d 206 (Supreme Court of Arkansas January 10, 1966).
[12] J. Schettino, State v. Perricone 37 N.J. 463 (Supreme Court of New Jersey June 4, 1962).

Massachusetts claim: "neither rights of religion nor rights of parenthood are beyond limitation."[13] This demonstrates that even religious freedom can be curtailed for the safety of society, and that parents cannot make decisions that will endanger the safety and health of their children. Arguably, refusing to vaccinate a child falls into this category.

With these precedents in mind, lawmakers must decide how best to enact vaccination policy. The constitutionality of compulsory vaccination laws has been established, but it is up to individual states to specify and enforce these laws. For example, Mississippi and West Virginia have very strict vaccination policies that do not allow for any religious or ideological exemptions (medical exemptions are always accepted). Following the measles outbreak at Disneyland in 2015, California amended its loose vaccination laws to look more like the laws of these two states; California now requires that all students receive their recommended vaccinations before entering public or private school.[14] This means that if a parent feels strongly enough about refusing vaccines, she must homeschool her children.

On the other hand, many states are relatively lenient with their vaccination policies; as mentioned in chapter two, forty-seven states allow for religious exemptions, and eighteen allow for both personal belief and religious exemptions.[15] Texas is one of these eighteen states, permitting all forms of exemption in public and private schools and putting Texans at risk for an outbreak.[16] Because of this, Texas lawmakers are trying to pass legislation that will require schools to release their vaccination information. This will include the campus's overall immunization rate, as well as how many students are opting out because of medical or ideological reasons. The law will at least allow parents to understand the environments that their

[13] Wiley Rutledge, Prince v. Massachusetts 321 U.S. 158 (Supreme Court of the United States January 31, 1944).
[14] "SB-277 Public Health: Vaccinations."
[15] "States With Religious and Philosophical Exemptions From School Immunization Requirements."
[16] Hotez, "How the Anti-Vaxxers Are Winning."

children are entering when they go to school, and will perhaps enable them to make more informed decisions about the schools to which they send their children.[17]

Tying vaccination to school enrollment is a great way to instate a compulsory vaccination program because it still gives parents the right to choose. Even in the strictest states, where religious and ideological exemptions are not accepted, parents may still keep their children unvaccinated if they also go to the trouble of homeschooling them. Thus, patient autonomy is never really taken away. In the few states that have very strict vaccination mandates, this method is also successful because it keeps unvaccinated children away from other healthy children. Therefore, if an unvaccinated child becomes sick, he will not spread it around a school.

While the laws in place are effective, I argue that they do not go far enough. Any allowance for religious or ideological exemptions is irresponsible to the community at large and to the individual children who are missing out on their vaccines. Going further, there are many other ways that the legal system can incentivize vaccines while still maintaining the principles of informed consent and patient autonomy. In the following chapter, I will explain these ideas and make recommendations for the most successful ways to ensure the immunity of a community.

[17] Joey Berlin, "Lawmakers Prepare Push for Reporting School Campus Vaccination Data," *Texas Medicine*, 2017.

Chapter 5

Recommendations for a Compulsory Vaccination Program

Once a vaccination program is put into place, there are many ways for the United States government to enforce it. However, just as the program itself must follow certain ethical guidelines, the methods of enforcement must reflect the ideals of an ethical and democratic society. It might be most effective to restrain non-compliant individuals and vaccinate them without consent, but this is not suitable for a country founded on a constitution that protects individual liberties (it also goes against the fifth criterion of the program itself, which is to require informed consent in non-emergency situations). On the other hand, the government cannot simply allow parents to choose; without incentive, vaccine hesitant and non-compliant parents would prevent the maintenance of herd immunity. This chapter will explore the many ways that a government may use policy to enforce a vaccination program, and will outline the best method.

The goal of vaccination policy is to create consequences that make non-compliance sufficiently unattractive. The first possible vaccination policy is to require parents to give legal consent to isolating or quarantining an unvaccinated child if they contract or come into contact with a communicable disease. Someone who has a confirmed case of disease may be isolated and someone who has come into contact with another sick person may be quarantined (in order to ensure that, if he has contracted the disease, he cannot spread it during the incubation period). Currently, there are several diseases that qualify for isolation and quarantine, including tuberculosis, smallpox, Ebola, and SARS.[1]

[1] "Understanding Quarantine and Isolation," *Centers for Disease Control and Prevention*, August 28, 2014, https://www.cdc.gov/quarantine/quarantineisolation.html.

There are many ethical issues associated with quarantine and isolation, mainly because many feel that it strips individuals of their liberties.[2] However, in this case, a parent would sign a contract to effectively nullify his child's liberties, which removes this ethical dilemma from the situation. Under this law, an individual would willingly allow his child to be isolated or quarantined if, for example, the child were unvaccinated and had spent a day at Disneyland in December 2014. This proposal would most likely deter the parents who would not want to see their children quarantined. For all other parents, it gives more leeway and autonomy regarding vaccination, and is therefore perhaps a smart way to appease the anti-vaccine movement while containing infectious diseases.

A similar idea is to hold parents responsible if their unvaccinated children become sick and spread an infectious disease, and to punish them accordingly. Tort law might play an important role in incentivizing vaccination. A tort is a civil wrong that causes injury for which a victim can receive compensation; the civil wrong in this situation is the decision not to vaccinate and the injury is the infectious disease. Such a policy would require the parents of unvaccinated children involved in outbreaks to cover the costs incurred by the outbreak, i.e., the healthcare costs and emotional damages suffered by the other victims.[3] When refusing vaccination, parents would sign a contract placing this responsibility on their shoulders. There are two important benefits to such a plan: first, it is more deterrent than a threat of quarantine or isolation, and second, it would provide compensation to families if an outbreak occurred.

However, there are a few problems associated with the ideas above. First, they may not serve as incentives to many parents who believe that their children will never be exposed to an

---

[2] Ross Upshur, "The Ethics of Quarantine," *Virtual Mentor* 5, no. 11 (November 1, 2003), doi:10.1001/virtualmentor.2003.5.11.msoc1-0311.

[3] This idea was initially proposed in the following article: Anthony Ciolli, "Mandatory School Vaccinations: The Role of Tort Law," *The Yale Journal of Biology and Medicine* 81, no. 3 (September 2008): 129–37.

infectious disease. If this is true, such policy may not help the population reach herd immunity. Second, isolation is not a foolproof method for containing a disease as contagious as the measles. An individual can remain in public for a long time during the asymptomatic period of the illness, all while spreading it to other children. Third, the cost of quarantining every unvaccinated person for all of these avoidable diseases would be astronomical; imagine if all unvaccinated individuals who came into contact with a mumps patient were forced into quarantine for two weeks—even if the individual is responsible for payment, it would still place a huge and unnecessary burden on the state. In addition, as far as tort law is concerned, it may be impossible to pinpoint the source of an outbreak. Finally, these methods still strip autonomy from the children, and would place ethical responsibility of any forced isolation or quarantine of a child onto the parents. These techniques would not be effective on their own, but may be good ways to supplement other vaccination laws.

If we work from a different angle, there are several more effective ways to incentivize vaccination. All of the above examples threaten punishment only *if* a child becomes sick, which is not enough for many parents. If the government wants all communities to reach the threshold of herd immunity, vaccination laws must create consequences for the act of refusing to vaccinate. One way to do this is to make child tax credit dependent on childhood vaccinations. In order to qualify for child tax credit, all dependents would have to keep up with the regular recommended vaccine schedule. For many families, this would be a great motivating factor. However, it misses a couple of populations. First, for those who do not qualify for any government benefits because of undocumented status, this would not function well as a motivating factor. In addition, families who make more than $110,000 per year receive fewer benefits, anyhow, so this may not serve as

a valuable deterrent for the wealthy.[4] This is especially problematic, since much of the anti-vaccine community tends to be affluent.

A similar avenue would be to link vaccination status to insurance premium costs. Health insurance premiums are calculated with several factors in mind. For example, insurance companies may charge tobacco users significantly more for health insurance policies.[5] This is based on the assumption that the adverse effects of tobacco usage will require insurance companies to spend more money on these individuals throughout their lifetimes. In addition, unlike many pre-existing conditions, tobacco use is voluntary and can therefore be legally targeted. Refusing vaccinations falls into the same category: a person who is voluntarily unvaccinated has a much higher chance of incurring health care costs associated with an infectious disease like the measles. Therefore, it is reasonable that insurance companies should take this into consideration when calculating premiums. It is a fair way to financially incentivize vaccinations for hesitant parents. However, similar to the child tax credit option, it may not successfully target the affluent parents that make up a large part of the anti-vax movement.

Another more effective method of compulsory vaccination is one that is widely used in the United States today, and has been discussed in previous chapters. Simply, a child must be vaccinated in order to enroll in school. Students may enter a school unvaccinated only if they have a medical exemption. This is exactly the model that California adopted in 2016. Senate Bill 277 "no longer permit[s] immunization exemptions based on personal beliefs for children in child care and public and private schools," but has no control over homeschooled students and

[4] "Ten Facts about the Child Tax Credit," *IRS*, May 29, 2015, https://www.irs.gov/uac/ten-facts-about-the-child-tax-credit.
[5] Alex C. Liber et al., "Tobacco Surcharges on 2015 Health Insurance Plans Sold in Federally Facilitated Marketplaces: Variations by Age and Geography and Implications for Health Equity," *American Journal of Public Health* 105, no. S5 (October 8, 2015): S696–98, doi:10.2105/AJPH.2015.302694.

other children who are not part of a classroom.[6] This method is effective because it forces parents to either vaccinate their children or homeschool them. Needless to say, homeschooling a child is a difficult undertaking with several long-term ramifications for the child, including, at the very least, an altered social environment. For many parents, including those whom the financial incentives neglect, this deterrent is compelling enough to push them to vaccinate their children.

Although the above system allows for some children to go without vaccines, communities remain safer because these children are homeschooled, i.e., separated from most other school-aged children on a regular basis. However, these children still remain a threat to community health when they enter public places such as Disneyland. If we do not allow unvaccinated children in schools, should we also prevent them from entering theme parks? In an ideal world, the answer would be yes. Practically speaking, though, requiring the submission of vaccination records before entering public places would place a significant burden onto enforcers of such a policy, and is therefore not a realistic incentive.

All of the above policies incentivize parents to vaccinate their children. However, what if this responsibility were placed onto schools instead? Another method of vaccine enforcement is to require schools to meet a certain threshold percentage of vaccination before opening for the school year. This percentage could be based on the threshold for herd immunity. It would account for children with medical exemptions, but would leave little room for personal belief or religious exemptions. Under this policy, outbreaks would become very unlikely in schools. However, it would be problematic for schools with high numbers of medical exemptions. In addition, it is not fair to penalize a school and its vaccinated students because of the actions of non-compliant parents (especially for compliant students who have no choice but to attend their

[6] "SB-277 Public Health: Vaccinations."

local public schools). Therefore, while this approach is effective in theory, it is unfeasible and unfair in practice.

The policies for a mandatory vaccine program must target parents, and the best singular way to ensure compliance is to link vaccination to school enrollment. Adding additional incentives makes reaching a high level of immunity even more likely. Therefore, pairing the school enrollment incentive with one or a few other incentives (e.g., higher insurance premium, no child tax credit, tort law, etc.) will result in the best outcome for the country. If the United States adopts such policies, it can avoid future outbreaks of vaccine-preventable disease.

Long-Term Solutions in the United States:

While compulsory vaccination laws are effective for preventing illness and eradicating certain diseases, they may not be the best long-term solution for the root issue. The unfortunate truth is that many parents do not want to vaccinate their children. The harsher policies recommended above could anger the vaccine hesitant community even more—the country will be immunized, but many will be unhappy. In fact, one study shows that mandating the administration of some vaccines (partial compulsory immunization) results in a 39% decrease in the acceptance of voluntary vaccines (e.g., HPV), simply because compulsory vaccination laws upset anti-vax communities.[7] Therefore, described here are some potential long-term solutions to the problem, which will hopefully encourage parents to make the wise decision when it comes to vaccinations in the future.

In order for the mass public to trust vaccinations wholeheartedly, it is necessary to refute what the media has falsely said about vaccinations in recent years. It is impossible to control

[7] Cornelia Betsch and Robert Böhm, "Detrimental Effects of Introducing Partial Compulsory Vaccination: Experimental Evidence," *European Journal of Public Health* 26, no. 3 (June 1, 2016): 378–81, doi:10.1093/eurpub/ckv154.

what celebrities say, regardless of how untrue their information is. One way to combat this misinformation is to release the truth in a similar manner. A pro-vaccine campaign sponsored by celebrities and famous politicians would likely undo some of the damage caused by Donald Trump and Jenny McCarthy. Comedian Mindy Kaling has already begun such a campaign. In an episode of her hit show, *The Mindy Project*, she references the importance of childhood vaccines. After her nanny dresses her son in a "no vaccine zone" onesie, citing the dangers of "Big Pharma," Mindy promptly fires her, explaining that vaccines also eliminated "big polio and big mumps."[8] Ilana Glazer and Abbi Jacobson also show support for vaccinations in their sitcom, *Broad City*, by framing an episode around a character's HPV vaccine experience.[9] A continuation of pro-vaccine sentiment in the popular media would be very beneficial.

The most important long-term solution for vaccine hesitancy is to develop strong vaccine education programs. First, children must learn about the importance and effectiveness of vaccinations during their early years in school. Today, science curricula that include information about vaccines are relatively common in high schools, but not in elementary or middle schools.[10] It would be beneficial to teach young children about vaccinations so that they grow up trusting them. In addition, the younger the child, the more likely he is to be eligible for certain vaccinations, or to have a younger sibling who is eligible; parents would perhaps be more likely to vaccinate their children if they request it themselves.

Education programs that target new parents would also be extremely beneficial. The pro-vaccine movement should encourage birthing and parenting classes to adopt curricula that teach parents about the benefits and safety of vaccines. In addition, vaccination is a topic that

---

[8] "Mindy and Nanny," *The Mindy Project* (Hulu, October 27, 2015).
[9] "Co-Op," *Broad City* (Comedy Central, February 23, 2016).
[10] Amanda F. Dempsey and Sarah Schaffer, "Middle- and High-School Health Education Regarding Adolescent Vaccines and Human Papillomavirus," *Vaccine* 28, no. 44 (October 18, 2010): 7179–83, doi:10.1016/j.vaccine.2010.08.066.

obstetricians should take ample time to discuss with their patients in order to prepare them for the decisions they will have to make once their babies are born. Mandatory workplace education programs would also be helpful in eliminating vaccine hesitancy among adults.

A combination of education and policy may be the optimal plan for a country establishing a mandatory vaccination program. Ontario is currently working to do just that. If Bill 198 is passed, the provincial government will "require parents to complete an immunization education session before filing a statement of conscious or religious belief."[11] The policy will hopefully convince many parents to change their minds before opting out of vaccination.[12] Some parents may decide not to submit an exemption simply to avoid the time commitment and hassle of the course. If nothing else, it will ensure that all parents are making informed decisions.

A similar program may be effective in the United States. Of course, there are some problems with the proposed policy. First, implementing an education session for all parents wishing to submit personal exemptions would be costly. Second, it may further anger anti-vax parents who are set in their ways. However, for parents who are at other points on the spectrum of vaccine hesitancy, a mandatory educational program could be very beneficial.[13] These individuals often submit exemptions because they are unsure about vaccines and have chosen to believe what popular media has told them. Therefore, unlike those who are 100% anti-vax, the parents who are sitting on the fence are likely to vaccinate their children once they spend the time to learn about the benefits of vaccinations. Adding the children of these fence-sitting parents to the immunized community may be enough to ensure herd immunity in all communities across the country.

---

[11] Eric Hoskins, "An Act to Amend the Immunization Fo School Pupils Act," Pub. L. No. 198 (2016).
[12] Alex Galbraith, "Canada Has A Novel Compromise For Those Parents Who Are Against Vaccinations," *UPROXX*, May 14, 2016, http://uproxx.com/news/canada-vaccinations-course-law/.
[13] Julie Leask, "Target the Fence-Sitters," *Nature; London* 473, no. 7348 (May 26, 2011): 443–45.

The ultimate approach of the future involves genetic screening. Needless to say, this will be more useful when the technology is cheaper and more readily available, but it has great potential to motivate vaccine hesitant parents to immunize their children. An example of when genetics can play a role in putting parents more at ease with their vaccine choices involves the MMR vaccine, which can cause febrile seizures in very rare cases. A 2014 study linked these febrile seizures to specific variants of two gene loci.[14] In other words, there is a small percentage of children more likely to react to the MMR vaccine with a febrile seizure, and they can be identified through genome sequencing. In the future, children who display this genotype would be medically exempt from receiving this vaccine, and parents of children who do not display this genotype would not have to worry about the harmful side effects of the vaccine. As genetics becomes more advanced and additional discoveries are made in this field, each child can receive safe and individualized care. This will alleviate vaccine hesitancy and guarantee the practice of immunization for the future.

[14] Bjarke Feenstra et al., "Common Variants Associated with General and MMR Vaccine-Related Febrile Seizures," *Nat Genet* 46, no. 12 (December 2014): 1274–82.

Conclusion

The American Medical Association's seventh principle of medical ethics states that "a physician shall recognize a responsibility to participate in activities contributing to the improvement of the community and the betterment of public health."[1] Vaccinations are one of the most important public health innovations of modern medicine. Although they pose some risks, their numerous benefits to individual and societal health make them a vital part of American and worldwide safety. Thanks to compulsory vaccination programs, smallpox has been eradicated around the world, polio cases have decreased by 99% since 1988,[2] and several other life-threatening infectious diseases are no longer risks in many countries, including the United States.

However, the current generation of young American parents presents a new threat to immunization efforts and the maintenance of herd immunity in our society. Unlike previous generations, who were exposed firsthand to the dangers of polio, measles, and pertussis, these parents see the vaccinations themselves as significant health risks. The presence of anti-vaccine sentiment among prominent figures in the media, including the president himself, only adds fuel to this fire and augments the challenges of the pro-vaccine community. Periodic outbreaks of measles in vaccine hesitant communities demonstrate the importance of this problem.

The rise of vaccine hesitancy poses many ethical issues to the government of the United States, which has an obligation to its public safety and welfare as well as to its individual citizens. However, ethically speaking, the United States government has the right to strongly

---

[1] Frank A. Riddick, "The Code of Medical Ethics of the American Medical Association," *The Ochsner Journal* 5, no. 2 (2003): 6–10.
[2] "Poliomyelitis," *World Health Organization*, 2017, http://www.who.int/mediacentre/factsheets/fs114/en/.

incentivize parents to vaccinate their children as long as its program follows a set of ethical guidelines. The method by which the government enacts policy to incentivize vaccination is crucial. Today, the laxity of many states' policies is what leads to outbreaks of disease, which is why vaccine mandates must be more stringent.

However, these policies will only solve the problem in the short term, and will eventually lead to considerable issues in public opinion. Parents must again be personally motivated to vaccinate their children, just as they were during the polio epidemic. Hopefully this will come from education and positive sentiment in mainstream media rather than from continued outbreaks of disease. In the long term, the country must work together to eliminate vaccine hesitancy as a risk to public health in order to better the world as a whole.

ACKNOWLEDGEMENTS

I would first like to thank my incredible supervisors, Dr. Jason Upton and Dr. Janet Davis, for guiding me through this project. Their constant enthusiasm and encouragement allowed me to remain confident and productive during the research and writing process. I also want to thank my family and friends for their undying support and helpful feedback, and my parents for taking me to get my vaccines when I was a child. Without them, I could not have completed this thesis in good health.

BIOGRAPHY

Ariella Noorily was born on May 10, 1995 in San Antonio, Texas. She enrolled in the Plan II Honors program at the University of Texas at Austin in the fall of 2013. Following her life-long dream to be a physician, she completed a pre-medical curriculum along with the philosophy, literature, and history classes of Plan II. Her interests in all of these disciplines inspired her thesis topic and allowed her to explore the issue of vaccinations from many different angles. She plans to apply to medical schools in 2017 and hopefully begin her medical studies in the fall of 2018.

References

"ADL Slams RFK Jr. for Vaccines-Holocaust Analogy." *Jewish Telegraphic Agency*, April 14, 2015. http://www.jta.org/2015/04/14/news-opinion/united-states/adl-slams-rfk-jr-for-vaccines-holocaust-analogy.

Alex Galbraith. "Canada Has A Novel Compromise For Those Parents Who Are Against Vaccinations." *UPROXX*, May 14, 2016. http://uproxx.com/news/canada-vaccinations-course-law/.

Allen, Arthur. "Vaccine Phobia Infects GOP Race." *POLITICO*. Accessed January 28, 2017. http://politi.co/1gvKDLP.

Andre, F. E., R. Booy, H. L. Bock, J. Clemens, S. K. Datta, T. J. John, B. W. Lee, et al. "Vaccination Greatly Reduces Disease, Disability, Death and Inequity Worldwide." *Bulletin of the World Health Organization* 86, no. 2 (February 2008): 140–46. doi:10.1590/S0042-96862008000200016.

Banzhoff, Angelika. "Multicomponent Meningococcal B Vaccination (4CMenB) of Adolescents and College Students in the United States." *Therapeutic Advances in Vaccines* 5, no. 1 (February 1, 2017): 3–14. doi:10.1177/2051013616681365.

Barlow, William E., Robert L. Davis, John W. Glasser, Phillip H. Rhodes, Robert S. Thompson, John P. Mullooly, Steven B. Black, et al. "The Risk of Seizures after Receipt of Whole-Cell Pertussis or Measles, Mumps, and Rubella Vaccine." *New England Journal of Medicine* 345, no. 9 (August 30, 2001): 656–61. doi:10.1056/NEJMoa003077.

Baxter, Roger, Joan Bartlett, Ali Rowhani-Rahbar, Bruce Fireman, and Nicola P. Klein. "Effectiveness of Pertussis Vaccines for Adolescents and Adults: Case-Control Study." *BMJ* 347 (July 17, 2013): f4249. doi:10.1136/bmj.f4249.

Bellini, William J., Jennifer S. Rota, Luis E. Lowe, Russell S. Katz, Paul R. Dyken, Sherif R. Zaki, Wun-Ju Shieh, and Paul A. Rota. "Subacute Sclerosing Panencephalitis: More Cases of This Fatal Disease Are Prevented by Measles Immunization than Was Previously Recognized." *The Journal of Infectious Diseases* 192, no. 10 (November 15, 2005): 1686–93. doi:10.1086/497169.

Bentham, Jeremy. *The Collected Works of Jeremy Bentham: An Introduction to the Principles of Morals and Legislation*. Clarendon Press, 1996.

Berezow, Alex, and Hank Campbell. "Ignore Anti-Vaccine Hysteria, Mr. Trump." *Wall Street Journal*, January 11, 2017, sec. Opinion. http://www.wsj.com/articles/ignore-anti-vaccine-hysteria-mr-trump-1484093196.

Berlin, Joey. "Lawmakers Prepare Push for Reporting School Campus Vaccination Data." *Texas Medicine*, 2017.

Betsch, Cornelia, and Robert Böhm. "Detrimental Effects of Introducing Partial Compulsory Vaccination: Experimental Evidence." *European Journal of Public Health* 26, no. 3 (June 1, 2016): 378–81. doi:10.1093/eurpub/ckv154.

Betsch, Cornelia, Robert Bohm, and Gretchen B. Chapman. "Using Behavioral Insights to Increase Vaccination Policy Effectiveness." *Policy Insights from the Behavioral and Brain Sciences* 2, no. 1 (2015): 61–73. doi:10.1177/2372732215600716.

Blume, Stuart, and Ingrid Geesink. "A Brief History of Polio Vaccines." *Science* 288, no. 5471 (June 2, 2000): 1593–94. doi:10.1126/science.288.5471.1593.

Cariello, Carrie. "My Son Has Autism — and I Am Not Anti-Vaccine." *TODAY.com*, February 5, 2015. http://www.today.com/health/my-son-has-autism-i-am-not-anti-vaccine-t836.

Cassell, Eric J. "The Principles of the Belmont Report Revisited: How Have Respect for Persons, Beneficence, and Justice Been Applied to Clinical Medicine?" *Hastings Center Report* 30, no. 4 (July 8, 2000): 12–21. doi:10.2307/3527640.

Centers for Disease Control and Prevention (CDC). "Pertussis Outbreak in an Amish Community--Kent County, Delaware, September 2004-February 2005." *MMWR. Morbidity and Mortality Weekly Report* 55, no. 30 (August 4, 2006): 817–21.

Chad Hayes. "My Kids Are Vaccinated Because I Love Them." *KevinMD.com*, April 19, 2017. http://www.kevinmd.com/blog/2017/04/kids-vaccinated-love.html.

Chappell, Bill. "2015 Traffic Fatalities Rose By Largest Percent In 50 Years, Safety Group Says." *The Two-Way: Breaking News from NPR*, February 18, 2016. http://www.npr.org/sections/thetwo-way/2016/02/18/467230965/2015-traffic-fatalities-rose-by-largest-percent-in-50-years-safety-group-says.

Chen, Sanny Y., Shoana Anderson, Preeta K. Kutty, Francelli Lugo, Michelle McDonald, Paul A. Rota, Ismael R. Ortega-Sanchez, et al. "Health Care–Associated Measles Outbreak in the United States After an Importation: Challenges and Economic Impact." *Journal of Infectious Diseases* 203, no. 11 (June 1, 2011): 1517–25. doi:10.1093/infdis/jir115.

Ciolli, Anthony. "Mandatory School Vaccinations: The Role of Tort Law." *The Yale Journal of Biology and Medicine* 81, no. 3 (September 2008): 129–37.

"Contraception and Birth Control." *NIH Eunice Kennedy Shriver National Institute of Child Health and Human Development*. Accessed March 14, 2017. https://www.nichd.nih.gov/health/topics/contraception/conditioninfo/Pages/faqs.aspx.

"Co-Op." *Broad City*. Comedy Central, February 23, 2016.

Cooper, Louis Z., Heidi J. Larson, and Samuel L. Katz. "Protecting Public Trust in Immunization." *Pediatrics* 122, no. 1 (July 1, 2008): 149–53. doi:10.1542/peds.2008-0987.

"Country List: Yellow Fever Vaccination Requirements and Recommendations; Malaria Situation; and Other Vaccination Requirements." World Health Organization. Accessed March 19, 2017. http://www.who.int/ith/ITH_country_list.pdf.

Daileda, Colin. "Donald Trump's Long History of Troubling Statements about Vaccines and Autism." *Mashable*, January 10, 2017. http://mashable.com/2017/01/10/donald-trump-vaccines-autism/.

Daniels, Kimberly, William D. Mosher, and Jo Jones. "Contraceptive Methods Women Have Ever Used: United States, 1982–2010." *National Health Statistics Reports, U.S. Department of Health and Human Services* 62 (February 14, 2013).

David, Silke, Ralph van Furth, and Frits R Mooi. "Efficacies of Whole Cell and Acellular Pertussis Vaccines against Bordetella Parapertussis in a Mouse Model." *Vaccine* 22, no. 15–16 (May 7, 2004): 1892–98. doi:10.1016/j.vaccine.2003.11.005.

Dayan, Gustavo H., Ismael R. Ortega-Sánchez, Charles W. LeBaron, and M. Patricia Quinlisk. "The Cost of Containing One Case of Measles: The Economic Impact on the Public Health Infrastructure—Iowa, 2004." *Pediatrics* 116, no. 1 (July 1, 2005): e1–4. doi:10.1542/peds.2004-2512.

Dempsey, Amanda F., and Sarah Schaffer. "Middle- and High-School Health Education Regarding Adolescent Vaccines and Human Papillomavirus." *Vaccine* 28, no. 44 (October 18, 2010): 7179–83. doi:10.1016/j.vaccine.2010.08.066.

Dubé, Eve, Caroline Laberge, Maryse Guay, Paul Bramadat, Réal Roy, and Julie A. Bettinger. "Vaccine Hesitancy." *Human Vaccines & Immunotherapeutics* 9, no. 8 (August 8, 2013): 1763–73. doi:10.4161/hv.24657.

"Duration of Live Measles Vaccine-Induced Immunity. : The Pediatric Infectious Disease Journal." *LWW*. Accessed December 3, 2016. http://journals.lww.com/pidj/Fulltext/1990/02000/Duration_of_live_measles_vaccine_induced_immunity_.8.aspx.

Eggen, Dan. "Rick Perry Reverses Himself, Calls HPV Vaccine Mandate a 'mistake.'" *Washington Post*. Accessed February 9, 2017. https://www.washingtonpost.com/politics/rick-perry-reverses-himself-calls-hpv-vaccine-mandate-a-mistake/2011/08/16/gIQAM2azJJ_story.html.

Eggertson, Laura. "Lancet Retracts 12-Year-Old Article Linking Autism to MMR Vaccines." *Canadian Medical Association Journal* 182, no. 4 (March 9, 2010): E199–200. doi:10.1503/cmaj.109-3179.

Eric Hoskins. An Act to Amend the Immunization fo School Pupils Act, Pub. L. No. 198 (2016).

Feenstra, Bjarke, Bjorn Pasternak, Frank Geller, Lisbeth Carstensen, Tongfei Wang, Fen Huang, Jennifer L Eitson, et al. "Common Variants Associated with General and MMR Vaccine-Related Febrile Seizures." *Nat Genet* 46, no. 12 (December 2014): 1274–82.

Fine, Paul. "Herd Immunity: History, Theory, Practice." *Epidemiologic Reviews* 15, no. 2 (1993): 265–302.

Fine, Paul, Ken Eames, and David L. Heymann. "'Herd Immunity': A Rough Guide." *Clinical Infectious Diseases* 52, no. 7 (April 1, 2011): 911–16. doi:10.1093/cid/cir007.

Fitzpatrick, John T. *Judicial Decisions on Public Law*. The American Political Science Review, 1917. http://archive.org/details/jstor-1943993.

Furstenberg, F F, K A Moore, and J L Peterson. "Sex Education and Sexual Experience among Adolescents." *American Journal of Public Health* 75, no. 11 (November 1, 1985): 1331–32. doi:10.2105/AJPH.75.11.1331.

Gangarosa, E. J., A. M. Galazka, C. R. Wolfe, L. M. Phillips, E. Miller, R. T. Chen, and R. E. Gangarosa. "Impact of Anti-Vaccine Movements on Pertussis Control: The Untold Story." *The Lancet* 351, no. 9099 (January 31, 1998): 356–61. doi:10.1016/S0140-6736(97)04334-1.

Gastañaduy, Paul A., Jeremy Budd, Nicholas Fisher, Susan B. Redd, Jackie Fletcher, Julie Miller, Dwight J. III McFadden, et al. "A Measles Outbreak in an Underimmunized Amish Community in Ohio." *New England Journal of Medicine* 375, no. 14 (October 6, 2016): 1343–54. doi:10.1056/NEJMoa1602295.

Geier, David A, and Mark R Geier. "An Evaluation of Serious Neurological Disorders Following Immunization: A Comparison of Whole-Cell Pertussis and Acellular Pertussis Vaccines." *Brain and Development* 26, no. 5 (August 2004): 296–300. doi:10.1016/S0387-7604(03)00169-4.

Goldsmith, Sadja. "San Francisco's Teen Clinic: Meeting the Sex Educaiton and Birth Control Needs of the Sexually Active Schoolgirl." *Family Planning Perspectives* 1, no. 2 (October 1969): 23–26.

Goldstein, Joseph. "Medical Care for the Child at Risk: On State Supervention of Parental Autonomy." *The Yale Law Journal* 86, no. 4 (1977): 645–70. doi:10.2307/795639.

González, Amy Berrington de, and Sarah Darby. “Risk of Cancer from Diagnostic X-Rays: Estimates for the UK and 14 Other Countries.” *The Lancet* 363, no. 9406 (January 31, 2004): 345–51. doi:10.1016/S0140-6736(04)15433-0.

Grabenstein, John D. “What the World’s Religions Teach, Applied to Vaccines and Immune Globulins.” *Vaccine* 31, no. 16 (April 12, 2013): 2011–23. doi:10.1016/j.vaccine.2013.02.026.

Gross, Liza. “Parents Who Shun Vaccines Tend To Cluster, Boosting Children’s Risk.” *NPR*, January 20, 2015. http://www.npr.org/sections/health-shots/2015/01/20/378630798/parents-who-shun-vaccines-tend-to-cluster-boosting-childrens-risk.

H, Shimizu. “[Inactivated poliovirus vaccine].” *Nihon rinsho. Japanese journal of clinical medicine* 69, no. 9 (2011 2011): 1604–8.

Haelle, Tara. “California Vaccination Bill SB 277 Signed By Governor, Becomes Law.” *Forbes*. Accessed February 13, 2017. http://www.forbes.com/sites/tarahaelle/2015/06/30/california-vaccination-bill-sb-277-signed-by-governor-becomes-law/.

“Healthline Presents: Polio Revisited.” *Healthline*. YouTube, 2008. https://www.youtube.com/watch?v=4S8Qr6Zfv8E.

Hill, Holly A., Laurie Elam-Evans, David Yankey, James Singleton, and Vance Dietz. “Vaccination Coverage Among Children Aged 19–35 Months — United States, 2015.” *MMWR. Morbidity and Mortality Weekly Report* 65 (2016). doi:10.15585/mmwr.mm6539a4.

Hill, Holly, Laurie Elam-Evans, David Yankey, James Singleton, and Maureen Kolasa. “National, State, and Selected Local Area Vaccination Coverage Among Children Aged 19–35 Months — United States, 2014.” *Morbidity and Mortality Weekly Report* 64, no. 33 (August 28, 2015): 889–96.

Holland, Mary. “Compulsory Vaccination, the Constitution, and the Hepatitis B Mandate for Infants and Young Children.” *Yale Journal of Health Policy, Law, and Ethics* 12, no. 1 (March 3, 2013). http://digitalcommons.law.yale.edu/yjhple/vol12/iss1/2.

Holt. Mannis v. State 398 S.W.2d 206 (Supreme Court of Arkansas January 10, 1966).

Hotez, Peter J. “How the Anti-Vaxxers Are Winning.” *The New York Times*, February 8, 2017. https://www.nytimes.com/2017/02/08/opinion/how-the-anti-vaxxers-are-winning.html.

“How Influenza (Flu) Vaccines Are Made | Seasonal Influenza (Flu) | CDC.” *Centers for Disease Control and Prevention*. Accessed December 4, 2016. http://www.cdc.gov/flu/protect/vaccine/how-fluvaccine-made.htm.

“HPV Vaccine Coverage Maps – Infographic.” *Centers for Disease Control and Prevention*, August 25, 2016. https://www.cdc.gov/hpv/infographics/vacc-coverage.html#text.

“HPV Vaccine Information For Young Women.” *Centers for Disease Control and Prevention*. Accessed February 9, 2017. https://www.cdc.gov/std/hpv/stdfact-hpv-vaccine-young-women.htm.

“HPV Vaccine: State Legislation and Statutes.” *National Conference of State Legislatures*. Accessed February 9, 2017. http://www.ncsl.org/research/health/hpv-vaccine-state-legislation-and-statutes.aspx.

“Information Sheet: Observed Rate of Vaccine Reactions, Polio Vaccines.” World Health Organization, May 2014.

"IRB Policies and Procedures Manual." The University of Texas at Austin Office of Research Support and Compliance. Accessed March 14, 2017. https://research.utexas.edu/ors/human-subjects/policies-and-procedures/.

Janko, Matthew. "Vaccination: A Victim of Its Own Success." *Virtual Mentor* 14, no. 1 (January 1, 2012): 3. doi:10.1001/virtualmentor.2012.14.1.fred1-1201.

"Jenny McCarthy: 'We're Not An Anti-Vaccine Movement ... We're Pro-Safe Vaccine.'" *FRONTLINE*. Accessed February 6, 2017. http://www.pbs.org/wgbh/frontline/article/jenny-mccarthy-were-not-an-anti-vaccine-movement-were-pro-safe-vaccine/.

John, Harlan. Jacobson v. Massacusetts, 197 U.S. 11 (United States Supreme Court February 20, 1905).

Karlamangla, Soumya. "Measles Outbreak Grows in L.A.'s Orthodox Jewish Community despite California's Strict New Vaccination Law." *Los Angeles Times*, January 21, 2017. http://www.latimes.com/local/california/la-me-ln-measles-20170120-story.html.

Kata, Anna. "A Postmodern Pandora's Box: Anti-Vaccination Misinformation on the Internet." *Vaccine* 28, no. 7 (February 17, 2010): 1709–16. doi:10.1016/j.vaccine.2009.12.022.

———. "Anti-Vaccine Activists, Web 2.0, and the Postmodern Paradigm – An Overview of Tactics and Tropes Used Online by the Anti-Vaccination Movement." *Vaccine*, Special Issue: The Role of Internet Use in Vaccination Decisions, 30, no. 25 (May 28, 2012): 3778–89. doi:10.1016/j.vaccine.2011.11.112.

Katz, Aya. "Gary Johnson Alters Position: Now Supports Mandatory Vaccination." *The Libertarian Republic*, August 25, 2016. http://thelibertarianrepublic.com/johnson-reverses-vaccination/.

Kennedy, Robert F. "Deadly Immunity." *Rolling Stone; New York*, July 30, 2005.

Khazan, Olga. "Wealthy L.A. Schools' Vaccination Rates Are as Low as South Sudan's." *The Atlantic*, September 16, 2014. https://www.theatlantic.com/health/archive/2014/09/wealthy-la-schools-vaccination-rates-are-as-low-as-south-sudans/380252/.

Kohler, Pamela K., Lisa E. Manhart, and William E. Lafferty. "Abstinence-Only and Comprehensive Sex Education and the Initiation of Sexual Activity and Teen Pregnancy." *Journal of Adolescent Health* 42, no. 4 (April 1, 2008): 344–51. doi:10.1016/j.jadohealth.2007.08.026.

Kurchak, Sarah. "I'm Autistic, And Believe Me, It's A Lot Better Than Measles." *Medium*, February 6, 2015. https://medium.com/the-archipelago/im-autistic-and-believe-me-its-a-lot-better-than-measles-78cb039f4bea.

Lai, Yun-Kuang, Jessica Nadeau, Louise-Anne McNutt, and Jana Shaw. "Variation in Exemptions to School Immunization Requirements among New York State Private and Public Schools." *Vaccine; Kidlington* 32, no. 52 (December 12, 2014): 7070–76. doi:http://dx.doi.org.ezproxy.lib.utexas.edu/10.1016/j.vaccine.2014.10.077.

Lauerman, Kerry. "Correcting Our Record." *Salon*. Accessed February 8, 2017. http://www.salon.com/2011/01/16/dangerous_immunity/.

Leask, Julie. "Target the Fence-Sitters." *Nature; London* 473, no. 7348 (May 26, 2011): 443–45.

Lee, Charlotte, Kathryn Whetten, Saad Omer, William Pan, and Daniel Salmon. "Hurdles to Herd Immunity: Distrust of Government and Vaccine Refusal in the US, 2002-2003." *Vaccine* 34, no. 34 (July 25, 2016): 3972–78. doi:10.1016/j.vaccine.2016.06.048.

Liber, Alex C., Jeffrey M. Drope, Ilana Graetz, Teresa M. Waters, and Cameron M. Kaplan. "Tobacco Surcharges on 2015 Health Insurance Plans Sold in Federally Facilitated Marketplaces: Variations by Age and Geography and Implications for Health Equity." *American Journal of Public Health* 105, no. S5 (October 8, 2015): S696–98. doi:10.2105/AJPH.2015.302694.

Lohr, Steve. "For Today's Graduate, Just One Word: Statistics." *The New York Times*, August 5, 2009. http://www.nytimes.com/2009/08/06/technology/06stats.html.

Louis, Brandeis. Zucht v. King 260 U.S. 174 (United States Supreme Court November 12, 1922).

Luhby, Tami. "Why so Many People Hate Obamacare." *CNN Money*, January 5, 2017. http://money.cnn.com/2017/01/05/news/economy/why-people-hate-obamacare/index.html.

Lüning, T. H., M. E. Keemers-Gels, W. B. Barendregt, A. C. I. T. L. Tan, and C. Rosman. "Colonoscopic Perforations: A Review of 30,366 Patients." *Surgical Endoscopy* 21, no. 6 (June 1, 2007): 994–97. doi:10.1007/s00464-007-9251-7.

Luthy, Karlen E., Renea L. Beckstrand, and Neil E. Peterson. "Parental Hesitation as a Factor in Delayed Childhood Immunization." *Journal of Pediatric Health Care: Official Publication of National Association of Pediatric Nurse Associates & Practitioners* 23, no. 6 (December 2009): 388–93. doi:10.1016/j.pedhc.2008.09.006.

McNeill, David. "Japan's National Immunisation Program Still Trails Europe." *Japan Today*, January 23, 2016. https://www.japantoday.com/category/health/view/japans-national-immunisation-program-still-trails-behind-europe.

"Measles History." *Centers for Disease Control and Prevention*, November 3, 2014. https://www.cdc.gov/measles/about/history.html.

"Measles Outbreak across Europe." *BBC News*, March 28, 2017, sec. Health. http://www.bbc.com/news/health-39419976.

Mill, John Stuart. *Utilitarianism*. Longmans, Green and Company, 1901.

"Mindy and Nanny." *The Mindy Project*. Hulu, October 27, 2015.

"Minnesota (USA) - Measles Update: Outbreak Expands." *DG Alerts: Anesthesiology*, April 28, 2017. http://dgalerts.docguide.com/minnesota-usa-measles-update-outbreak-expands.

Mnookin, Seth. *The Panic Virus: A True Story of Medicine, Science, and Fear*. New York: Simon and Schuster, 2011.

"Monitoring the Impact of the Varicella Vaccination." *Centers for Disease Control and Prevention*, July 1, 2016. https://www.cdc.gov/chickenpox/surveillance/monitoring-varicella.html.

Moore, Wendy. "Paralysed with Fear: The Story of Polio by Gareth Williams – Review." *The Guardian*, July 17, 2013, sec. Books. https://www.theguardian.com/books/2013/jul/17/paralysed-fear-polio-williams-review.

Morales, Alvaro, Maria M. Martinez, Anne Tasset-Tisseau, Elena Rey, Florence Baron-Papillon, and Alain Follet. "Costs and Benefits of Influenza Vaccination and Work Productivity in a Colombian Company from the Employer's Perspective." *Value in Health* 7, no. 4 (July 1, 2004): 433–41. doi:10.1111/j.1524-4733.2004.74006.x.

Moran, Jeffrey P. *Teaching Sex: The Shaping of Adolescence in the 20th Century*. Cambridge, Massacusetts: Harvard University Press, 2000.

"Multiple Vaccines and the Immune System Concerns." *Centers for Disease Control and Prevention*, August 7, 2016. https://www.cdc.gov/vaccinesafety/concerns/multiple-vaccines-immunity.html.

Murray, Patrick R., Ken S. Rosenthal, and Michael A. Pfaller. "Antimicrobial Vaccines." In *Medical Microbiology*, 5th ed., 159–66. Philadelphia: Elsevier Mosby, 2005.

"National Vaccine Injury Compensation Program." *US Department of Health and Human Services: Health Resources and Services Administration*, February 2017. https://www.hrsa.gov/vaccinecompensation/.

"Nuremberg Code." *United States Holocaust Memorial Museum*. Accessed March 23, 2017. https://www.ushmm.org/information/exhibitions/online-exhibitions/special-focus/doctors-trial/nuremberg-code.

Offit, Paul A., and Charlotte A. Moser. "The Problem With Dr Bob's Alternative Vaccine Schedule." *Pediatrics* 123, no. 1 (January 1, 2009): e164–69. doi:10.1542/peds.2008-2189.

Offit, Paul A., Jessica Quarles, Michael A. Gerber, Charles J. Hackett, Edgar K. Marcuse, Tobias R. Kollman, Bruce G. Gellin, and Sarah Landry. "Addressing Parents' Concerns: Do Multiple Vaccines Overwhelm or Weaken the Infant's Immune System?" *Pediatrics* 109, no. 1 (January 1, 2002): 124–29. doi:10.1542/peds.109.1.124.

Oshinsky, David M. *Polio: An American Story*. Oxford: Oxford University Press, 2005.

Park, Alice. "Doctor behind Vaccine-Autism Link Loses License." *Time*. Accessed February 6, 2017. http://healthland.time.com/2010/05/24/doctor-behind-vaccine-autism-link-loses-license/.

Paskett, Electra. "We Have a Vaccine for Six Cancers, so Why Are Less than Half of Kids Getting It?" *The Conversation*, February 6, 2017. http://theconversation.com/us.

Peck, Peggy. "Trump Denies Naming Vax Skeptic to Safety Panel," January 10, 2017. http://www.medpagetoday.com/InfectiousDisease/Vaccines/62452.

"Pertussis Reported Cases." *WHO World Health Organization: Immunization, Vaccines And Biologicals*, December 1, 2016. http://apps.who.int/immunization_monitoring/globalsummary/timeseries/tsincidencepertussis.html.

Plotkin, Stanley A., ed. *History of Vaccine Development*. New York: Springer, 2011.

Poland, Gregory A., Robert M. Jacobson, and Inna G. Ovsyannikova. "Trends Affecting the Future of Vaccine Development and Delivery: The Role of Demographics, Regulatory Science, the Anti-Vaccine Movement, and Vaccinomics." *Vaccine* 27, no. 25–26 (May 26, 2009): 3240–44. doi:10.1016/j.vaccine.2009.01.069.

"Polio Endemic Countries." *Global Polio Eradication Initiative*, 2017. http://polioeradication.org/.

"Poliomyelitis." In *Epidemiology and Prevention of Vaccine-Preventable Diseases*, 13th ed., 297–310. Atlanta: Centers for Disease Control and Prevention, 2015. http://www.cdc.gov/VACCINes/pubs/pinkbook/downloads/hib.pdf.

"Poliomyelitis." *World Health Organization*, 2017. http://www.who.int/mediacentre/factsheets/fs114/en/.

"Possible Side Effects from Vaccines." *Centers for Disease Control and Prevention*. Accessed December 4, 2016. http://www.cdc.gov/vaccines/vac-gen/side-effects.htm#flu.

Rao, T. S. Sathyanarayana, and Chittaranjan Andrade. “The MMR Vaccine and Autism: Sensation, Refutation, Retraction, and Fraud.” *Indian Journal of Psychiatry* 53, no. 2 (2011): 95–96. doi:10.4103/0019-5545.82529.

Reichman, Edward. “Halachic Aspects of Vaccinations.” Bikur Cholim, February 19, 2012. www.bikurcholim.net.

“Reported Cases and Deaths from Vaccine Preventable Diseases, United States, 1950-2013.” In *Epidemiology and Prevention of Vaccine-Preventable Diseases*, 13th ed. Centers for Disease Control and Prevention, 2015.

Research, Center for Biologics Evaluation and. “Biologics License Applications (BLA) Process (Biologics) - Vaccine Product Approval Process.” WebContent. *U.S. Food and Drug Administration*. Accessed March 7, 2017. https://www.fda.gov/BiologicsBloodVaccines/DevelopmentApprovalProcess/BiologicsLicenseApplicationsBLAProcess/ucm133096.htm.

Riddick, Frank A. “The Code of Medical Ethics of the American Medical Association.” *The Ochsner Journal* 5, no. 2 (2003): 6–10.

Riedel, Stefan. “Edward Jenner and the History of Smallpox and Vaccination.” *Baylor University Medical Center Proceedings* 18, no. 1 (2005): 21–25.

Romanus, V., R. Jonsell, and S. O. Bergquist. “Pertussis in Sweden after the Cessation of General Immunization in 1979.” *The Pediatric Infectious Disease Journal* 6, no. 4 (April 1987): 364–71.

Roos, Robert. “Reports Support Usefulness of School-Based Flu Vaccination.” *Center for Infectious Disease Research and Policy*, April 19, 2010. http://www.cidrap.umn.edu/news-perspective/2010/04/reports-support-usefulness-school-based-flu-vaccination.

Roush, Sandra W., Trudy V. Murphy, and and the Vaccine-Preventable Disease Table Working Group. “Historical Comparisons of Morbidity and Mortality for Vaccine-Preventable Diseases in the United States.” *JAMA* 298, no. 18 (November 14, 2007): 2155–63. doi:10.1001/jama.298.18.2155.

Rutledge, Wiley. Prince v. Massachusetts 321 U.S. 158 (Supreme Court of the United States January 31, 1944).

Sandler, Benjamin Pincus. *Diet Prevents Polio*. Lee Foundation for Nutritional Research, 1951.

“SB-277 Public Health: Vaccinations.” *California Legislative Information*, 2015. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB277.

Schettino, J. State v. Perricone 37 N.J. 463 (Supreme Court of New Jersey June 4, 1962).

“Seat Belts.” *Governors Highway Safety Association: The States’ Voice on Highway Safety*, 2016. http://www.ghsa.org/state-laws/issues/Seat-Belts.

Sepic, Matt. “Public Health Workers Push Back against Anti-Vaccine Claims at Somali Community Meeting,” May 1, 2017. https://www.mprnews.org/story/2017/05/01/public-health-workers-push-back-against-anti-vaccine-claims-somali-community-meeting.

Shahzad, Aamir. “Time for a Worldwide Shift from Oral Polio Vaccine to Inactivated Polio Vaccine.” *Clinical Infectious Diseases* 49, no. 8 (October 15, 2009): 1287–88. doi:10.1086/605691.

Shrestha, Sundar S., David L. Swerdlow, Rebekah H. Borse, Vimalanand S. Prabhu, Lyn Finelli, Charisma Y. Atkins, Kwame Owusu-Edusei, et al. “Estimating the Burden of 2009 Pandemic Influenza A (H1N1) in the United States (April 2009-April 2010).” *Clinical*

Infectious Diseases: An Official Publication of the Infectious Diseases Society of America 52 Suppl 1 (January 1, 2011): S75-82. doi:10.1093/cid/ciq012.

Siddiqui, Mariam, Daniel A Salmon, and Saad B Omer. "Epidemiology of Vaccine Hesitancy in the United States." *Human Vaccines & Immunotherapeutics* 9, no. 12 (December 1, 2013): 2643–48. doi:10.4161/hv.27243.

"Side Effects of GARDASIL®9 (Human Papillomavirus 9-Valent Vaccine, Recombinant)." Accessed December 4, 2016. https://www.gardasil9.com/about-gardasil9/side-effects-and-safety/.

Sifferlin, Alexandra. "More Women Want IUDs after President Trump's Election." *Time*, January 26, 2017. http://time.com/4650190/iud-trump-election/.

Smith, Morgan. "Which Texas Schools Have the Highest Rates of Vaccine Exemptions?" *The Texas Tribune*, July 14, 2016. https://www.texastribune.org/2016/07/14/see-studnet-vaccine-exemptions-school/.

Soave, Robby. "Forget the Anti-Vaxxers: Libertarian Parenting Is Perfectly Healthy." *Reason.com*, February 6, 2015. http://reason.com/blog/2015/02/06/forget-the-anti-vaxxers-libertarian-pare.

"States With Religious and Philosophical Exemptions From School Immunization Requirements." *National Conference of State Legislatures*, August 23, 2016. http://www.ncsl.org/research/health/school-immunization-exemption-state-laws.aspx.

Stehr-Green, Paul, Peet Tull, Michael Stellfeld, Preben-Bo Mortenson, and Diane Simpson. "Autism and Thimerosal-Containing Vaccines: Lack of Consistent Evidence for an Association." *American Journal of Preventive Medicine* 25, no. 2 (August 2003): 101–6. doi:10.1016/S0749-3797(03)00113-2.

Sun, Lena. "The United States Already Has a Vaccine Safety Commission. And It Works Really Well, Experts Say." *Washington Post*, January 13, 2017. https://www.washingtonpost.com/news/to-your-health/wp/2017/01/13/the-u-s-already-has-a-vaccine-safety-commission-and-it-works-really-well-experts-say/.

Syckle, Katie Van, and Katie Van Syckle. "Tribeca Film Festival Pre-Party: Filmmakers Weigh in on 'Vaxxed' Controversy." *Variety*, April 13, 2016. http://variety.com/2016/film/news/tribeca-film-festival-2016-filmmaker-party-vaxxed-1201752508/.

"Ten Facts about the Child Tax Credit." *IRS*, May 29, 2015. https://www.irs.gov/uac/ten-facts-about-the-child-tax-credit.

"The Global Eradication of Smallpox: Final Report of the Global Commission for the Certification of Smallpox Eradication." World Health Organization, December 1979.

"Thimerosal in Vaccines." *Centers for Disease Control and Prevention*, August 27, 2015. https://www.cdc.gov/vaccinesafety/concerns/thimerosal/.

Thomas, Katie. "The Race for a Zika Vaccine." *The New York Times*, November 19, 2016. https://www.nytimes.com/2016/11/20/business/testing-the-limits-of-biotech-in-the-race-for-a-zika-vaccine.html.

Trump, Donald J. "Healthy Young Child Goes to Doctor, Gets Pumped with Massive Shot of Many Vaccines, Doesn't Feel Good and Changes - AUTISM. Many Such Cases!" Microblog. *@realdonaldtrump*. Accessed February 9, 2017. https://twitter.com/realdonaldtrump/status/449525268529815552?lang=en.

"Understanding Quarantine and Isolation." *Centers for Disease Control and Prevention*, August 28, 2014. https://www.cdc.gov/quarantine/quarantineisolation.html.

Upshur, Ross. “The Ethics of Quarantine.” *Virtual Mentor* 5, no. 11 (November 1, 2003). doi:10.1001/virtualmentor.2003.5.11.msoc1-0311.
“U.S. Public Health Service Syphilis Study at Tuskegee.” *Centers for Disease Control and Prevention*, December 22, 2015. https://www.cdc.gov/tuskegee/timeline.htm.
“Vaccine Contraindications and Precautions Recommendations | CDC.” *Centers for Disease Control and Prevention*. Accessed November 20, 2016. http://www.cdc.gov/vaccines/hcp/admin/contraindications.html.
“Vaccines for Children Program.” *Centers for Disease Control and Prevention*, February 18, 2016. https://www.cdc.gov/vaccines/programs/vfc/index.html.
“Vaxxed: From Cover-Up to Catastrophe Official Website.” *Vaxxed*. Accessed February 7, 2017. http://vaxxedthemovie.com/.
Verweij, Marcel, and Angus Dawson. “Ethical Principles for Collective Immunisation Programmes.” *Vaccine* 22, no. 23–24 (August 13, 2004): 3122–26. doi:10.1016/j.vaccine.2004.01.062.
Verweij, Marcel F., and Hans Houweling. “What Is the Responsibility of National Government with Respect to Vaccination?” *Vaccine* 32, no. 52 (December 12, 2014): 7163–66. doi:10.1016/j.vaccine.2014.10.008.
Wenger, Olivia K., Mark D. McManus, John R. Bower, and Diane L. Langkamp. “Underimmunization in Ohio’s Amish: Parental Fears Are a Greater Obstacle Than Access to Care.” *Pediatrics*, June 22, 2011, peds.2009-2599. doi:10.1542/peds.2009-2599.
“WHO | Pertussis.” *World Health Organization*. Accessed March 8, 2017. http://www.who.int/biologicals/vaccines/pertussis/en/.
“WHO World Health Organization: Immunization, Vaccines And Biologicals. Vaccine Preventable Diseases Vaccines Monitoring System 2016 Global Summary Reference Time Series: MUMPS.” Accessed December 4, 2016. http://apps.who.int/immunization_monitoring/globalsummary/timeseries/tsincidencemumps.html.
“Wiping Out Polio: How The U.S. Snuffed Out A Killer.” *All Things Considered*. NPR, October 15, 2012.
Zhou, Fangjun, Abigail Shefer, Jay Wenger, Mark Messonnier, Li Yan Wang, Adriana Lopez, Matthew Moore, Trudy V. Murphy, Margaret Cortese, and Lance Rodewald. “Economic Evaluation of the Routine Childhood Immunization Program in the United States, 2009.” *Pediatrics* 133, no. 4 (April 1, 2014): 577–85. doi:10.1542/peds.2013-0698.
Zipprich, Jennifer, Kathleen Winter, Jill Hacker, Dongxiang Xia, James Watt, and Kathleen Harriman. “Measles Outbreak: California, December 2014-February 2015.” *Morbidity and Mortality Weekly Report* 64, no. 6 (February 20, 2015): 153–54.